SCIENCE

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

OPSONINS AND OTHER ANTIBODIES[1]

LOOKING back, we find that only fifty years ago the conception of the nature of the processes that run their courses in the animal body in infectious diseases, generally speaking, were hazy and still often even mystical. Preceded by occasional brilliant anticipations, notably by Bretonneau in regard to the specificness of infectious processes and by Henle with respect to the interaction between parasite and host, the tireless, unmeasurably fruitful investigation of the modern era, introduced by Pasteur and Koch, has brought to light not only the actual causes of many infectious diseases, but a great deal also in regard to the means and reactions in the infected body whereby they are overcome. Of these defensive processes phagocytosis and the action and formation of that remarkable group of bodies known as antibodies have received and still receive the greatest amount of attention. Indeed, the discovery of the wonderful power of the animal organism to respond to the effects of certain substances by the production of new antibodies must be reckoned as one of the great events, not only in medicine, but in general biology. We feel best acquainted with the antitoxins, the lysins, the agglutinins, the precipitins and the opsonins, but this does not exhaust the list, which is a growing one. The estab-

[1] Address of the vice-president and chairman of Section K—Physiology and Experimental Medicine, American Association for the Advancement of Science, Baltimore, 1908.

lishment of curative serum therapy by Behring when he demonstrated that antitoxic serum protects healthy animals against fatal doses of the corresponding toxin and may even cure the already sick, served to turn to the common good this innate faculty of the animal body to develop in so marvelous a manner its own resources.

Let it be noted once more that serum treatment, which has robbed diphtheria of its former terrors and the benefits of which are being extended to other diseases, is the direct outcome of scientific animal experimentation, and that without such experimentation it would not have been discovered and could not be maintained and extended.

The new methods and principles developed by the study of the animal reactions to infection did not long remain the exclusive property of the workshop of the bacteriologist. Ehrlich's side-chain theory of toxic and antitoxic action proved most heuristic, leading directly to fruitful investigation of other fields, and to-day biology, clinical and legal medicine, and physiological chemistry are using *immunological* methods to solve important problems.

According as stress was placed on the part of phagocytosis, on the one hand, and on the rôle of antibodies, antimicrobic as well as antitoxic, on the other hand, investigators until but recently were largely partisans of either the phagocytic or the humoral theory of healing and immunity. But the sharp antagonism between the adherents of these theories has subsided, because it has been made clear that neither mode of action is accomplished without the cooperation of cells and fluids. This is particularly true and easy of demonstration in the case of phagocytosis. Metchnikoff, the genial founder of the phagocytic theory, by broad comparative studies established the general occurrence and the significance in health and disease of phagocytosis in the higher as well as in the lower animals, and Denys and others have shown that the fluids of the blood play an essential part in the phagocytic process by so acting on microbes and other elements that they are made susceptible of phagocytic action. This property of the blood-fluid is now ascribed to definite substances, the opsonins of Wright and Douglas, and the tropins of Neufeld, both in all probability the same substances, and destined, I believe, to bear the name of opsonins, at least in the English language. While our acquaintance with the opsonins dates back only four or five years, they have been the subject of many researches, and much has been written about them, and it is to some more or less final results and certain general bearings of this work, fruit of the phagocytic theory as modified and perfected by the opsonic theory, that I wish to direct your attention.

It is generally accepted that phagocytosis of many bacteria—and also of red blood corpuscles, which are highly serviceable objects for the study of certain problems—is dependent upon substances—opsonins—which become attached to the bacterial cells or corpuscles, as the case may be, and so alter them that they are readily taken up by the leukocytes. The chief reasons for this conclusion are that leukocytes, carefully freed by repeated washing in salt solution, from the fluids in which they naturally exist, have but very little or no phagocytic power with respect to certain bacteria or corpuscles suspended in salt solution, while the same bacteria or corpuscles, after having been treated with suitable opsonic serum and then freed from the serum, are taken up by serum-free leukocytes. A few bacteria, however, *e. g.*, influenza bacilli, are readily phagocytable without the presence of opsonic serum.

Bacteria or corpuscles are not necessarily altered in opsonic serum and many bacteria, notably streptococci, pneumococci, anthrax bacilli, as well as others, grow freely in such serum. Heretofore the belief that phagocytes may cause destruction of bacteria rested largely upon more or less convincing morphological appearances. By means of the plate method for demonstrating bactericidal action it now has been shown conclusively that certain bacteria that do not suffer demonstrable injury by blood serum alone, such as those just mentioned, undergo intraphagocytic destruction when put into mixtures containing living leukocytes and opsonically active serum. In serum alone and in suspensions of serum-free leukocytes active growth occurs, but when the two are mixed destruction takes place, other factors being equal, in proportion to the number of leukocytes present. The actual demonstration of phagocytic annihilation of bacteria, formerly so often demanded by the opponents of the phagocytic theory, is here furnished.

The indications are that various opsonins with more or less well-marked specific affinities occur in all animals down to and including the echinoderms, being, like other antibodies, present to a variable extent in normal blood and other fluids.

In the course of his studies on lymph formation Professor Carlson[2] finds that opsonins and related bodies are more concentrated in the serum than in the lymph, that their concentration varies in the lymph from different organs, and that their apparent relative concentration in different lymphs also varies. The fact that the relative concentration is not the same in all lymphs speaks of course strongly in favor of the antibodies being distinct substances, a point concerning which there is still difference of opinion, some believing that it concerns different modes of action of the same body, others that each action is dependent upon a distinct body.

At first opsonins were regarded as substances of a relatively simple structure, quite easily destroyed by heat (60° C. for 15 to 30 minutes) and other agents. But it has been found that in most cases the total opsonic effect of fresh serum is the result of the combined action of two bodies, one relatively resistant to heat, the other easily destroyed by heat. The heat-resistant element is capable of opsonic action by itself and seems to unite quite firmly with the object upon which it acts; the opsonic effect as measured by the resulting phagocytosis is, however, greatly promoted on the addition of the other, thermolabile element, which alone has no opsonic power. In other words, opsonins, as a rule, seem to have the same duplex constitution as the lysins with which they are held by some to be identical.

The heat-resistant opsonic element appears to attach itself firmly to the bacterium or corpuscles upon which it acts because, in some instances at least, it is not detached even after many washings of the opsonified bacteria or corpuscle in large quantities of salt solution. Consequently opsonification is to be regarded as the special action of a distinct unit and not as the result of the influence of plasma or serum as a whole. The thermolabile, activating element, however, according to the results of recent experiments, probably remains free in the fluid of the phagocytic mixture, and there seems to me to be good room still for question as to whether its effect is exercised upon the phagocytable object or upon the phagocyte. Years ago Metchnikoff expressed the view that serum may stimulate leukocytes and other cells directly to phagocytosis, while, on the other hand, bacteria or red blood corpuscles that

[2] Personal communication.

take up what he and his followers then called "fixateur" thereby are made phagocytable. It is not impossible that further analysis of the mechanism of phagocytosis, under the guidance of the opsonic theory, will lead to this as the final result. At all events the failure to recognize the interaction of the two elements in the opsonic function of serum and the great difference in their combining properties is responsible for many of the divergent results of various investigators.

While normal blood contains only comparatively small amounts of heat-resistant opsonic substances, each unquestionably possessed of more or less well-marked specific affinities, the blood in conditions of acquired immunity may be richly charged with newly formed thermostable opsonic substances with marked specific affinity for the object against which the immunity is directed. Injections of suitable animals with bacteria or with alien red corpuscles cause specific opsonins to form; in human beings new opsonins arise as the result either of spontaneous infections or of the artificial introduction of killed bacteria and various bacterial products.

The opsonin content of the blood may be measured more or less accurately, either by means of the opsonic index or by determination of the highest dilution of the serum at which opsonic effect is still obtainable and comparing it with some normal standard. Speaking only in general terms, the opsonic index of Wright with respect to a given bacterium is obtained by comparing the number of bacteria taken up under the influence of the serum of the person or animal in question with the number taken up under the influence of the corresponding standard of normal serum under conditions that are as comparable as they possibly can be made.

By following the fluctuations of the opsonin content at frequent intervals important facts have been learned in regard to the laws of opsonin production. In the language of immunology any substance capable of giving rise to antibodies in suitable animals is called an antigen. Microbes and various microbic derivatives, cells, red corpuscles and serum may contain several antigens and incite the formation of more than one kind of antibody so far as indicated by the usual modes of antibody effect. Thus the proper single injection in a suitable animal of typhoid bacilli or of alien red cells is followed usually by the appearance in the blood of increased amounts of lysins (lytic amboceptors), agglutinins and opsonins for the particular cells injected. Usually all three of the bodies mentioned are not increased in the same proportions so far as determinable by our present methods of measurement, but they all commonly follow the same general course, which seems to hold good for antibodies in general: For the first day or two or three there is often, but apparently not always, a fall below normal in the amount of the specific antibodies in the serum; this period is called the negative phase and is succeeded by a steady rise above the normal, which, as a general rule, reaches its maximum about the eighth to twelfth day when there is a fall, the apex of the curve being sometimes quite sharp, at other times more rounded, and then begins a gradual return to the normal.

It is important to note that the fall below normal, the negative phase, is specific, that is, affects only the normal opsonin, and by inference the other antibodies, for the particular bacterium or corpuscles injected, a clear indication, it strikes me, that there are several normal antibodies, each with specific affinities and probably not different from the corresponding body formed when the machinery of immuniza-

tion is set in motion. The cause of this interesting negative phase is not well understood, but it lies closely at hand to ascribe it to neutralization of the normal antibodies by the antigen, or to its effect on the antibody-forming cells. There is good reason to believe, especially on clinical grounds, that the general resistance to the specific infection is lowered in the negative phase, although certain experimental results indicate that the opposite may be the case.

Blood serum may contain antigens causing the production of antibodies for its homologous corpuscles; thus, the injection of antidiphtheric horse serum is followed by a wave-like rise and fall of the lysin, agglutinin and opsonin for horse corpuscles in the blood of the patient, the highest point being reached usually about the tenth day. Undoubtedly these antigenic substances are derived from disintegration of the corpuscles.

Serum and other protein mixtures also induce the formation of specific precipitating substances in suitable animals. Whether the specific precipitin test for protein material, now extensively used for the identification of blood and in the solution of allied problems, will prove of service also in the study of pure proteins, remains to be seen.

In several acute infectious diseases the course of the formation of new opsonin for the infecting agent, in the typical attack, terminating promptly in recovery without complications, shows a marked general resemblance to the opsonin or antibody curve after a single antigen injection in the normal animal. It also bears definite and constant relations to the clinical phenomena. During the early stages when the symptoms are pronounced there is a negative phase, and then as the symptoms begin to subside the opsonin curve rises above normal, reaching the highest point several days after the onset, followed by a gradual subsidence. This is true of the pneumococcus opsonin in pneumonia, of the opsonin for the diphtheria bacillus in diphtheria, of the streptococcus opsonin in erysipelas, and also of the opsonin for the diplococcus of mumps in that disease. The curve is typical as well for the streptococcus in scarlet fever, indicating clearly that this organism unquestionably plays a definite rôle in scarlet fever whatever its actual causative relation to the disease may be. In pneumonia the greatest rise in the leukocytosis appears to precede somewhat the highest rise of the opsonin. In all these diseases the typical wave-like opsonin curve is modified by the development of complications of various kinds and at the onset of which it commonly undergoes a distinct depression. In rapidly fatal cases, for instance of pneumonia, the opsonic curve or index may not return from the primary depression but sink lower and lower. In prolonged infections, general as well as local, there occur irregular fluctuations and in chronic, more or less stationary cases, the opsonic index is often subnormal. At this time further details can not be given. My chief point is to make clear the close association between recovery and the wave-like rise of the opsonin and, as a result of the immunization, in all likelihood also of other antibodies in the typical attack of acute so-called self-limited infections. In some of the diseases the opsonin is the only antibody that we can measure readily with our present means. As I have stated, intraphagocytic destruction of pneumococci and streptococci takes place in the presence of fresh leukocytes and opsonic serum, whereas either alone constitutes a good medium for these bacteria. Taking these facts into account, it seems to me that the wave-like course of the opsonin in pneumonia and in acute streptococcus infec-

tions is a strong point on the side of the importance of phagocytosis in their healing, whatever other measures, of which at present we know less or nothing, may be in operation also.

Whether the opsonic action of serum is caused by distinct and independent substances or by antibodies with other actions as well, has been an interesting question concerning which there is still difference of opinion. The question now seems to be narrowed down to whether the opsonins and lysins are the same, some claiming that opsonification merely is the result of an early stage of lysis before actual solution takes place. Opsonins would appear to be distinct from other antibodies because a given serum may be opsonic, but not lytic, while the reverse probably also occurs. But here certain difficulties arise. While it is well established that serum may be strongly opsonic without being lytic and without even containing lytic amboceptor so far as our present methods indicate, the suggestion is made that in such cases the failure to obtain lysis may be owing to the state of the object tested and not to the absence of lysins. This consideration applies with most effect to instances in which we know the bacterium or corpuscle is susceptible both to lysis and to opsonification, and in which lysis might not take place either because the serum was not active enough or because of some special resistance to lysis. The explanation falls short, however, when applied to bacteria like pneumococci and streptococci, which, while readily opsonified, are yet insusceptible to lysis. In this case the claim that lysis does not take place because of the physical state of the bacteria is merely an assumption.

If opsonification and lysis depend upon the same body the opsonic and lytic powers of the serum of an animal in the course of immunization should always run parallel. If they do so that fact does not of itself prove that it concerns one body, but failure to run parallel would indicate the existence of separate bodies with different functions. Actual observations show that in certain animals single injections of alien red corpuscles may increase the opsonic power of the serum for that corpuscle a hundred times or more above normal, while the lytic power for the same corpuscle may be increased comparatively much less and in some conditions not at all. On this account, then, as well as for other reasons, the view that opsonins, meaning thereby the thermostable opsonic substances, constitute a distinct class of antibodies, seems to me to be correct.

That the activating or complementing opsonic substance is closely related to the complement of lysis is indicated by a number of considerations: Both are sensitive to the action of heat, being destroyed by an exposure of thirty minutes to 58–60° C.; both appear to be split up into two distinct components by water, and both are neutralized by a number of ionizable salts. As stated before, the opsonic complement, however, seems to remain free in the phagocytic mixtures, whereas the complement of lysis is regarded generally as bound by the amboceptor.

We come now to a most interesting part of our subject, namely, the resistance offered by microbes under different conditions to antibodies and more particularly to opsonins.

Since the discovery of the chronic microbe carrier the adaptation of microbes to the defensive mechanisms of the animal body is no longer merely of academic interest. Under the conception that phagocytosis and bacteriolysis form the basis of healing and immunity in perhaps most of the infectious diseases, the infecting microbes should disappear at the time of recovery. This is probably the general rule,

but there are many striking exceptions illustrated well by the now familiar "*bacillus carrier.*" The body may overcome the disease but not the cause, which may persist in spite of the increase in antibodies. The disease subsides, the disturbances are smoothed away, and yet the germ lives on in the host, apparently harmless and unharmed, sometimes for remarkably long periods. But the equilibrium is not always a stable one; the immunity of the host may give way and recurrence develop; or the resistance of the germ may weaken and eventually complete destruction and final elimination take place.

Germs isolated from typhoid and cholera carriers have been found in some cases to offer special resistance to antibodies, including opsonins, but the mechanisms of this mutual immunization of microbe and host are still obscure, and on account of the self-evident and tremendous importance of the carrier in spreading disease they invite special study.

At this point I may recall that the relapses in relapsing and related fevers are now ascribed to the survival in each attack of a few spirilla which, having become immune to the antibodies of the host, give origin to new "serum-fast" strains that continue the relapses.

Exceedingly interesting conditions are found in certain chronic infections of the urinary tract with bacilli of the colon group, the indications being that the infecting bacillus may partially immunize itself, in one case to the lysin, in another to the opsonin, in the patient's blood, or that the amounts of different antibodies vary greatly in the different cases.

In Metchnikoff's original doctrine of phagocytosis in infectious diseases a fundamental tenet reads that as a microbe grows in virulence its resistance to phagocytosis increases. Recent experiments give results in complete harmony with this teaching. On analysis the resistance of certain highly virulent bacteria to phagocytosis is found to depend on insusceptibility to opsonic action, owing apparently to lack of affinity for the opsonin. As pneumococci, streptococci and other bacteria on successive passages through suitable animals become more and more virulent for these animals, they at the same time acquire a parallel increase in resistance to phagocytosis. When cultivated outside the body reversion readily takes place to less virulent states, associated with a returning affinity for opsonin and an increasing susceptibility to opsonic action. Investigating this property of pneumococci to develop such strong defense against phagocytosis, Rosenow found that extraction or autolysis of virulent pneumococci brings into solution a substance or group of substances that neutralize the pneumococco-opsonin in human serum, but not other opsonins. After extraction of this substance, which is thermostable and insoluble in alcohol or ether, virulent pneumococci unite with opsonin and become phagocytable, while avirulent pneumococci on treatment with extracts of virulent strains not only become resistant to phagocytosis in the test-tube, but also to some degree virulent for animals.

Entirely independently, Tchistovitch and Yourevitch appear to have reached identical results on all points, except that they did not study the virulence of avirulent pneumococci after treatment with extracts of virulent strains.

We may say then that the properties called *virulence* in pneumococci appear to depend, to a very large extent, if not wholly, on the formation of an actual substance—"virulin"[3]—which may be extracted and studied by itself. It is hoped that this demonstration may prove a basis

[3] "Antiphagin"—Tchistovitch and Yourevitch.

of departure for new and fruitful work in pneumococcus and similar infections.

Ludvig Hektoen
Memorial Institute for Infectious Diseases, Chicago

THE FIRST ANNUAL CONFERENCE OF THE GOVERNORS IN NEW ENGLAND

In these days of conventions and association gatherings, it is difficult to select one on the grounds of special importance or significance. Among those which I have had the privilege of attending in recent years, the conference held in Boston, November 23 and 24, easily surpassed all others of material import when measured by the importance of the subjects considered and the vast possibility of bettering existing conditions. This was the first annual conference of the Governors of the New England states, called for the purpose of considering certain natural industries and utilities common to all, and legislation affecting them.

The conference was presided over by Governor Curtis Guild, Jr., of Massachusetts, and attended by every governor in office and governor-elect with one exception, namely, Governor Higgins, of Connecticut, "who had married a wife and therefore could not come."

Subjects Considered.—There were three sessions, and each session was devoted to the consideration of one subject, or a correlated group of subjects. The first session was devoted to tree planting interests, and this was divided into two parts: (1) Forest trees and (2) orchard trees.

The forest-tree side was discussed by Mr. Gifford Pinchot, United States forester, who showed impressively how rapidly the forest supplies of the country were decreasing; how vast areas of lands in New England, of little or no value for farming, might be utilized; the profitableness of forests as a commercial enterprise; and then finally urged the passage of uniform legislation in New England providing adequate protection of forest lands against fires. This subject aroused a lively discussion, and drew attention to the reasonable opportunities for safe investment of capital.

Orchard Trees.—The planting of apple trees on the hilly lands in New England, not in the valley farming lands, was urged by the professor of horticulture of Cornell University. He did this on the ground that New England was the natural home of the apple in the United States, for it was here that the leading commercial varieties of to-day originated; that the land was cheap, that labor was abundant, and markets both foreign and domestic convenient. Moreover, the quality of the New England apple was unsurpassed by that produced in any other section. The demand was keen, and for fruit of fine quality New England markets were the best in the country.

What was needed to improve the situation was reorganization of ideas and practises in relation to orcharding. The slipshod methods of generations and the opening of new irrigated fruit lands in the west discouraged on the one hand the would-be planter, and on the other attracted his attention to the opportunities in distant lands. What in his opinion was now needed was the redirection of capital to apple-growing as a staple and safe industry. We should have illustration orchards, planted and conducted either by men of faith in the business with sufficient capital to back up the enterprise, or by the state governments themselves. Such work should be conducted with the energy characterizing western enterprises, and guided by intelligence and up-to-date methods. Certain legislation was required in order to secure a uniform grade, uniform methods of packing, and certain standard packages.

The second session of the conference was devoted to a consideration of the fast-disappearing lobster and the much-preyed-upon mollusks.

These subjects were discussed by experts and aroused much interest. They proved their contention that these staple sea foods were in a fair way to be exterminated within a measurable length of time, and that without intelligent protection a great natural re-

source of most of the New England states would disappear.

Highways.—The highway problem, of course, aroused an interesting discussion, for here the advocates of the purely utilitarian met the devotees of pleasure on a common ground. Methods of constructing highways, the repair of highways and the influence of the automobile on the life of the highway, were live issues of this general topic. The necessity of constructing trunk lines whereby the leading centers of New England should be directly connected, and the necessity of providing for adequate maintenance, suggested the desirability of cooperation in the prosecution of these purely interstate projects.

The conference was made up then of these three sessions, crowded full of features of interest. In addition to the eleven governors, a number of invited delegates representing the topics mentioned above were present, and were allowed the courtesy of the floor for their periods.

Mr. F. L. Dean, secretary to Governor Guild, acted as executive secretary of the conference and will have charge of printing the report of the proceedings.

A feature of the conference was the masterly, and one might say artistic, way in which the speakers were introduced and the discussion expanded, or repressed as occasion seemed to demand, by the versatile chairman, Governor Guild, of Massachusetts. Undoubtedly the first of a great series of conferences, whereby questions of common import to the New England states shall be considered impartially and uncolored by political surroundings, has been launched, and unquestionably it will be followed by others even more influential in character.

JOHN CRAIG

DR. GIUSEPPE NOBILI

PROFESSOR LORENZO CAMERANO in the *Bollettino dei Musei di Zoologia ed Anatomia comparata della R. Università di Torino,* Vol. XXIII., number 595, announces the death of Dr. Giuseppe Nobili on the fourth of December, 1908, at Omegna, Italy. He was the son of Dr. Gaudenzio and Adele Antonioli Nobili and was born at Omegna, February 11, 1877. He received his doctor's degree in natural science at the Royal University of Turin in 1899, becoming also an assistant in the Zoological Museum of that University, and later (1903) was made an assistant in the Museum of Comparative Anatomy.

While a student at the university he engaged in some botanical researches and published several interesting notes. He soon, however, turned his attention to zoology and as early as 1896 wrote a paper on the decapod crustaceans collected by Dr. A. Borelli in the Argentine Republic and Paraguay. This was the first of a long series of publications chiefly on Crustacea (Decapoda, Stomatopoda, Isopoda, etc.) based on collections in the museum at Turin, and also in those at Geneva, Genoa, Naples, Paris, Budapest and Madrid. These papers (53 titles in all) contain descriptions of many new genera and species and critical discussions of others, and form an important contribution to our knowledge of the Crustacea. Foremost among them is his monographic work on the decapods and stomatopods of the Red Sea, published in the *Annales des Sciences Naturelles* (9), IV., 1906. Professor Camerano pays a high tribute to the personal character of Dr. Nobili, who, by his unwearying activity, had built up the collections in the Turin Museum, and by his kindness of heart had won the affection and esteem of his associates.

DARWIN ANNIVERSARY ADDRESSES AT THE UNIVERSITY OF CHICAGO

THE Biological Club of the University of Chicago has arranged the following program:

February 1—Introductory remarks by President H. P. Judson.

"The World's Debt to Darwin," Professor E. G. Conklin, Princeton University.

February 2—"The World of Thought Before and After the Publication of the Origin of Species," Professor G. H. Mead.

February 4—"Cosmic Evolution," Professor F. R. Moulton.

February 9—"Bridging the Gap between Living and Lifeless," Professor A. P. Mathews.

February 10—"Phylogeny," Professor S. W. Williston.

February 17—"Variation and Heredity," Professor W. L. Tower.

February 18—"The Interpretation of Environment," Professor H. C. Cowles.

February 24—"Darwinism and Political Science," Professor C. E. Merriam.

February 25—"Human Evolution—Physical and Social," Dr. Geo. A. Dorsey.

March 3—"The Influence of Darwinism on Psychology," Professor J. R. Angell.

March 4—"The Theory of Individual Development," Professor F. R. Lillie.

March 10—"The Evolution of Religion," Professor Shailer Mathews.

March 11—"Darwinism and Experimental Methods in Botany," Professor D. T. MacDougal, Carnegie Institute.

March 17—"Evolution in Language and in the Study of Language," Professor C. D. Buck.

March 18—"Selection Mutation and Orthogenesis," Professor C. O. Whitman.

SCIENTIFIC NOTES AND NEWS

Dr. James B. Angell proposes to present his resignation as president of the University of Michigan on February 17. It is understood that the office of chancellor will be created and that he will be the first to occupy this position.

Dr. Wilhelm Trabert, professor of cosmical physics at Innsbruck, has been appointed director of the Austrian Bureau of meteorology and geodynamics, vacant by the death of Professor Pernter.

Dr. Frank Wigglesworth Clarke, chemist, U. S. Geological Survey, and professor of mineral chemistry in the George Washington University, has been invited by the Chemical Society of London to deliver a memorial lecture on Dr. Wolcott Gibbs. As Professor Clarke is to attend the International Congress of Applied Chemistry, which meets in London on May 27, this lecture will follow shortly after the adjournment of the congress.

The Academy of Natural Sciences of Philadelphia has elected as correspondents the following: Dr. Albert Calmette, of Lille; Dr. Sven Hedin, of Stockholm; Dr. Robert F. Scharff, of Dublin, and Dr. John M. Clarke, of Albany.

Sir James Dewar and Dr. Ludwig Mond have been elected honorary members of the German Chemical Society.

M. P. Villard has been elected a member of the Paris Academy of Sciences in the Section of Physics to succeed M. Mascart.

On the recommendation of a committee of the Royal Society of Arts and the Royal College of Physicians, the Swiney prize, of the value of $1,000, has been awarded to Dr. C. A. Mercier, for his work on "Criminal Responsibility."

A new portrait of President Eliot, of Harvard University, by Mr. Charles Hopkinson has been hung in the Harvard Union, where it will remain for the next few days. The portrait represents President Eliot seated at his desk.

Mr. H. F. Newall, assistant director of the Observatory, Cambridge, has been elected a fellow of Trinity College.

We regret to learn that the illness of Professor G. D. Louderback, of the department of geology of the University of California, has made it necessary for him to take an indefinite leave of absence.

Professor F. W. Blackmar, head of the department of sociology in the University of Kansas, who has spent four summers in investigating the chief irrigating plants in western states, has finished a report on the development of irrigation and the reclamation service of the government in the arid west. This report will be published by the Carnegie Institution of Washington.

Professor Trevor Kincaid, of the department of zoology, University of Washington, will leave Seattle about the first of April for Simferopol, Crimea, Russia, where he will undertake, for the U. S. Bureau of Entomology, the collection and shipment of parasites of the Gypsy moth. During the absence of Professor Kincaid, Professor A. D. Howard, Ph.D. (Harvard), formerly of Westminster College, Pennsylvania, will have charge of the department.

MR. L. F. NOBLE, graduate student in geology at Yale University, has returned from a six-months' trip in the Lower Colorado Canyon, where he has been pursuing studies in structural geology, particularly with reference to the Algonkian.

Nature states that Professor E. A. Minchin has left England for three months, accompanied by his assistant, Dr. Woodcock, on a visit to the zoological station at Rovigno, in order to carry on researches on the development of the trypanosome of the little owl (*Athene noctua*).

DR. CHARLES WILLIAM ANDREWS, F.R.S., assistant in the Geological Department of the Natural History Museum, London, has returned from Christmas Island, in the Indian Ocean, where he has been making scientific researches.

DR. SVEN HEDIN delivered at Stockholm on January 22 a lecture upon his travels in Central Asia before a large audience, which included King Gustav and the royal family, and the members of the Anthropological and Geographical Societies. The Wahlburg medal of the latter society has been conferred on Dr. Sven Hedin, and the society has raised a fund of over $2,500 to be known by the explorer's name, which will be devoted to geographical research.

PROFESSOR A. G. WEBSTER, of the department of physics at Clark University, is giving three lectures under the auspices of the Sigma Xi Society at each of the universities of Missouri, Kansas, Nebraska and Iowa, and one each at Wisconsin and Northwestern, speaking on the present outlook in physics and on his researches in acoustics.

DR. R. S. WOODWARD, president of the Carnegie Institution of Washington, lectured to the students of the University of Wisconsin on the evening of February 2 on the work of that institution.

DR. WM. A. NOYES, professor of chemistry in the University of Illinois and editor of the *Journal of the American Chemical Society,* delivered an address before the Saint Louis Chemical Society, on January 29, on "Lavoisier." After the meeting an informal dinner was held in honor of the speaker.

PROFESSOR WM. J. GIES, of the department of biological chemistry of Columbia University, is conducting a course of public lectures on "The Chemistry of Digestion" on Monday evenings at Cooper Union. The lectures are illustrated by zoetrope figures, and by chemical and digestive demonstrations.

SIGMA XI lectures at the University of California have been given as follows: "The Effect of Solutions on Plant Growth," by Professor W. J. V. Osterhout; "Some Recent Discoveries in Solar Physics," by Professor E. P. Lewis; "The Origin and Distribution of Shell Mounds in the San Francisco Bay Region," by Mr. N. C. Nelson.

AT the meeting of the American Nature-study Society held at Baltimore the following officers were elected for 1909: *President,* Professor C. F. Hodge, of Clark University, Worcester, Mass. *Vice-presidents*—Professor V. L. Kellogg, of Stanford University, Cal.; Professor F. L. Stevens, North Carolina College of Agriculture and Mechanic Arts, Raleigh, N. C.; Professor W. Lochhead, Macdonald College, Quebec; Professor O. W. Caldwell, The University of Chicago; Professor B. M. Davis, Miami University, Oxford, O. *Directors* (for two years)—G. H. Trafton, Public Schools, Passaic, N. J.; Professor F. L. Holtz, Brooklyn Training School, N. Y.; Professor J. Dearness, Normal School, London, Canada; Mrs. Anna Botsford Comstock, Cornell University, Ithaca, N. Y., and Dr. Ruth Marshall, Milwaukee High Schools. Directors D. J. Crosby, C. R. Mann, S. Coulter, H. W. Fairbanks and M. F. Guyer and Secretary M. A. Bigelow were elected in 1908 to serve two years.

A SCIENCE CLUB has been organized among the members of the agricultural department of Delaware College and the Agricultural Experiment Station staff. The following officers were elected: *President,* Professor C. A McCue; *Vice-president,* Professor C. O. Houghton; *Secretary,* Professor A. E. Grantham. Weekly meetings will be held.

The executive council of the British Science Guild has considered the matter of naming London streets after distinguished men of science. The members of the executive committee were requested to send in names which were reduced to the following thirty-one: Newton, Darwin, Harvey, Jenner, Huxley, James Watt, Gilbert, Kelvin, Faraday, Joule, Clerk Maxwell, Stokes, Tyndall, Captain Cook, Livingstone, Franklin, Ross, Bruce, Mungo Park, Cavendish, Dalton, Priestley, Boyle, Andrews, Halley, Herschel, Horrocks, Adams, Bradley, Howard, Piddington.

At the meeting of the American Philosophical Society, on February 5, Professor E. G. Conklin, of Princeton University, offered a minute in commemoration of the centenary of the birth of Charles Darwin.

The Botanical Society of Pennsylvania has arranged a special meeting to commemorate the one hundredth anniversary of Darwin's birth and the fiftieth anniversary of the publication of the "Origin of Species." This will be held on Friday evening, February 12, in Biological Hall, University of Pennsylvania. The program consists of "A Short Sketch of Darwin's Life," by Dr. Henry Leffman; "Pre-Darwinian Theories of Plant Life," by Dr. Louis Krautter; "Darwin's Contribution to Botany," by Dr. J. W. Harshberger; and "Present Day Views on Organic Evolution," by Dr. C. H. Shaw.

The deaths are announced of Dr. Hermann Minkowski, professor of mathematics at Göttingen, and Dr. Otto Rupp, professor of geometry at Brünn.

The U. S. Civil Service Commission announces an examination on February 24, to fill a vacancy in the position of scientific assistant, $720 per annum, in the Bureau of Fisheries, and vacancies requiring similar qualifications as they may occur.

The next meeting of the Physical Society will be held at Columbia University, New York, on Saturday, February 27.

Professor W. A. Setchell has made a gift to the University of California of his herbarium, consisting of 15,468 specimens of algæ.

Numerous requests are received by the Geological Survey from educators, publishers and lecturers for photographs and lantern slides, in most cases those desiring them being willing to defray the expense of making the prints or slides, but there is at present no provision of law under which they can be furnished by sale. Some of these views taken by members of the survey have been used in a limited way by the survey in its publications; but many of these are out of print, leaving the photographic negatives to a large extent an unused resource of the public—data belonging to the public, but not available to it. If response could be made by the survey to the demands for prints from such negatives it would be in the interest of education and the dissemination of knowledge; and the survey being willing to supply reproductions from its great collection of photographic material, Senator Flint, of California, has introduced a proposed amendment to the civil service bill which reads as follows:

That the director of the Geological Survey shall hereafter furnish to any person, concern, or institution, in the interest of education and the dissemination of knowledge, that shall pay in advance the whole cost of material and services thereof, copies of any photographs or lantern slides in the possession of the United States Geological Survey; and the moneys received by the director for the same shall be deposited in the United States Treasury to the credit of the appropriation "Geological maps of the United States" of the said Geological Survey, and this provision shall become effective immediately.

A bill to establish a bureau in the Department of the Interior to be known as the Children's Bureau, has been introduced in the House of Representatives. It reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be established in the Department of the Interior a bureau to be known as the Children's Bureau.

Sec. 2. That the said bureau shall be under the direction of a chief, to be appointed by the President, by and with the advice and consent of the Senate, and who shall receive an annual compensation of five thousand dollars. The said bureau shall investigate and report upon all mat-

ters pertaining to the welfare of children and child life, and shall especially investigate the questions of infant mortality, the birth rate, physical degeneracy, orphanage, juvenile delinquency and juvenile courts, desertion and illegitimacy, dangerous occupations, accidents and diseases of children of the working classes, employment, legislation affecting children in the several states and territories, and such other facts as have a bearing upon the health, efficiency, character and training of children. The chief of said bureau shall, from time to time, publish the results of these investigations.

SEC. 3. That there shall be in said bureau, until otherwise provided for by law, an assistant chief, to be appointed by the Secretary of the Interior, who shall receive an annual compensation of three thousand dollars; one private secretary to the chief of the bureau, who shall receive an annual compensation of one thousand five hundred dollars; a chief clerk, who shall receive an annual compensation of two thousand dollars; one statistical expert, at two thousand dollars; four clerks of class four; four clerks of class three; two clerks of class two, and six clerks of class one; five clerks, at one thousand dollars each; two copyists, at nine hundred dollars each; one messenger, at seven hundred and twenty dollars; two special agents, at one thousand four hundred dollars each, and two special agents, at one thousand two hundred dollars each.

SEC. 4. That the Secretary of the Interior is hereby directed to furnish sufficient quarters for the work of this bureau at an annual rental not to exceed two thousand dollars.

SEC. 5. That this act shall take effect and be in force from and after its passage.

COLUMBIA UNIVERSITY has arranged a series of free public lectures on Sanitary Science and Public Health which will be given in the large lecture room of the College of Physicians and Surgeons, No. 437 West 59th Street, on Mondays and Wednesdays during February, March and April. They will begin each day at 5 P.M., and the doors will be closed ten minutes later. The first lecture, "The Rise and Significance of the Public Health Movement," by William Thompson Sedgwick, professor of biology at the Massachusetts Institute of Technology, was given on February 1. Among the other lecturers and their subjects will be Professor Adami, of McGill University, "The Great Pathological Discoveries and their Bearing upon Public Health Problems"; Professor Burr, of Columbia University, "Water Supplies and Sewage Disposal"; "Public Health Problems of the Municipality, State and Nation," by Thomas Darlington, Health Commissioner of this city; Walter Bensel, Sanitary Superintendent; Eugene H. Porter, State Health Commissioner, and Walter Wyman, Surgeon General, Public Health and Marine Hospital Service of the United States; H. M. Biggs, Chief Medical Officer of the New York Health Department, on "The Prevention of Tuberculosis," and Professor Theobold Smith, on "Diseases of Animals Transmissible to Man."

THE Cancer Commission of Harvard University announces a course of lectures on "Tumors," to be given on Thursday afternoons, at 5 o'clock, in the medical school. The lectures will be open to members of the university and to physicians. The dates and titles follow:

February 4—"The Bearing of the Experimental Investigation of Tumors on the Tumor Problem in General," by Dr. E. E. Tyzzer, Boston.

February 11—"The Regulatory Processes of Tumor Cells," by Dr. W. T. Howard, Cleveland, O.

February 18—"The Classification of Tumors," by F. B. Mallory, Boston.

February 25—"The Physiological Pathology of Intracranial Tumors," by Dr. Harvey Cushing, Baltimore, Md.

March 4—"The Etiology of Tumors considered from our Knowledge of Congenital Tumors and Tumors following Repeated Injury," by Dr. S. B. Wolbach, Albany, N. Y.

March 11—"The Problem of Cancer considered from the Standpoint of Immunity," by Dr. F. P. Gay, Boston.

PROFESSOR W. W. CAMPBELL, director of the Lick Observatory, writes that Volume VIII. of the publications of the observatory, now issuing from the bindery of the State Printing Office, Sacramento, contains heliogravure reproductions of the late Director Keeler's photographs of nebulæ and star clusters made with the Crossley reflector. Other contents are a description of the Crossley reflecting telescope by Director Keeler, a list of the nebulæ and clusters photographed, a catalogue of 744 new

nebulæ discovered on the negatives, and new determinations of the positions of the nebulæ previously known in the regions of the sky covered. It is hoped that the regular correspondents of the Lick Observatory can be supplied promptly with copies. The cost of the volume has been unusually high on account of the expensive processes and materials employed. There are 71 full-page heliogravure reproductions, printed by hand press on suitable paper.

THE Cleveland Chemical Society has organized itself into a local section of the American Chemical Society with the following officers: *President,* Franklin T. Jones; *Secretary,* Sherley P. Newton; *Board of Managers,* H. V. Arny, W. R. Veazey, president and secretary *ex-officio; Councilor,* C. F. Mabery. A charter has also been granted for the formation of a section of the American Chemical Society comprising the western portion of the state of Washington with headquarters at Seattle.

AT the recent meeting of the Southern Society for Philosophy and Psychology, held at the Johns Hopkins University, Baltimore, Md., the following officers were elected for 1909: *President,* Professor Albert Lefevre, University of Virginia; *Vice-president,* Dr. Shepherd Ivory Franz, Government Hospital for the Insane, Washington, D. C.; *Secretary-treasurer,* Professor Edward Franklin Buchner, Johns Hopkins University. To serve three years as members of the council: Professor James Franklin Messenger, State Normal School, Farmville, Va.; Professor Robert Morris Ogden, University of Tennessee. Other members of the council are: Dr. William Torrey Harris, Washington, D. C.; President D. B. Purinton, West Virginia University; Professor James Mark Baldwin, Johns Hopkins University; Principal Reuben Post Halleck, Louisville, Ky.

UNIVERSITY AND EDUCATIONAL NEWS

MRS. ESTHER GOWEN HOOD has given the University of Pennsylvania $100,000 to establish graduate fellowships in the law department. The gift is a memorial to her father, the late Franklin B. Gowen.

MR. ADOLPHUS BUSCH, who last August promised to contribute $50,000 towards the $300,000 necessary for the erection of the new building for the Germanic Museum at Harvard University, has increased his gift to $100,000.

THE General Education Board has offered to give Bryn Mawr College $250,000 on condition that friends of the college subscribe $280,000 by June, 1910. This is in addition to the $100,000 recently given by the alumnæ. Of this sum $130,000 is to be used to pay the debt of the college, and the balance is to be reserved as an endowment fund.

THE building for the new California Museum of Vertebrate Zoology, at the University of California, is now under construction. Its cost, which is to be about $14,000, is to be met in part by the regents' appropriation of $7,000, and in part by an arrangement with Miss Annie Alexander, the patron of this new department, whereby she adds $7,000 with the provision that her annual grant for maintenance for the next seven years shall be $6,000 instead of $7,000, as at first proposed by her.

THE regents of the University of Colorado have authorized the establishment of a summer laboratory for botany and zoology at Tolland, Colo., altitude 8,889 feet. The laboratory will be in charge of the regular instructing staff of the university, and there will be courses in elementary biology, plant anatomy, plant taxonomy and ecology. The location of the laboratory is such that students can study the plants and animals of all the different life zones from plains to alpine heights. Work done at the laboratory will count toward a degree in the university.

DR. FAIRBAIRN, who will retire from the principalship of Mansfield College, Oxford, at Easter, has given to the college his valuable theological and philosophical library.

DR. E. A. NOBLE was installed as president of the Woman's College of Baltimore on February 2, when addresses were delivered by

President Noble, Dr. H. S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching; Dr. Elmer E. Brown, U. S. commissioner of education; Dr. Ira Remsen, president of the Johns Hopkins University and Mr. John E. Semmes, president of the Baltimore school commissioners.

DR. FRANK L. MCVEY has been elected president of the University of North Dakota. He was formerly professor of economics at the University of Minnesota and is now chairman to the tax commission of the state.

THE trustees of Columbia University have appointed Dr. William G. MacCallum, professor of pathological physiology in the Johns Hopkins University, to be professor of pathology in succession to Dr. T. Mitchell Prudden, who will retire from active service on July 1 next. At the same time the trustees have made provision for the development and extension of the departments of bacteriology under professor Philip H. Hiss, Jr., and of clinical pathology under Professor Francis C. Wood. Increased attention will be paid by these departments to the needs of advanced students and investigators.

AT the College of the City of New York, Dayton J. Edwards has been appointed tutor in natural history. He is a graduate of the University of Maine, and has lately been an assistant at Columbia University.

MR. G. H. COX has been appointed instructor at the University of California in geology and mineralogy.

DISCUSSION AND CORRESPONDENCE

EDUCATION AND THE TRADES

TO THE EDITOR OF SCIENCE: In your issue for November 14 Mr. William Kent asks a question which interests me greatly and which, although I can not answer, I believe I can lay down the lines along which the answer must be made.

In the first place, I wish to express my unqualified approval of the letter of Stella V. Kellerman in your issue of November 13, with which Mr. Kent expresses agreement, but which causes him to ask the question referred to. Latin, Greek and the mathematics have been taught for so many centuries that we have learned how to get out of them the highest possible degree of pedagogic value. This merely means that we have learned how, by means of studies of this character, to get hard work out of the student, while at the same time we maintain his interest. I assume that the pedagogic value of a study is largely comprehended in the possibility of teaching in the manner above mentioned. A great many people who honestly believe that our system of education should take more account of the daily affairs of life fear that when we replace any of the old studies by new ones which relate to modern industries, the work of the schools will lose its pedagogic value. Speaking in a general way, I believe this will be true, but this is not because the new studies do not have this value in them, but because we have not yet learned how to get it out of them. I believe there are some things which have higher pedagogic value than anything taught in our schools to-day, else why is it that with only 29 per cent. of our population actually living on the farm, with miserably poor school facilities as compared with our city population, this 29 per cent. furnishes about 70 per cent. of the leaders in every phase of activity in this country?

The point I wish to make is further illustrated by an instance that occurred in connection with the school garden work in Washington city schools. The teacher in charge had found difficulty in getting boys twelve to fifteen years old to lay off the plats properly. Two little boys, six and eight years old, from the hills of Virginia, came into school, never having seen plats laid off, but it was found that even the younger of these, if put in charge of a squad of boys twice his age, would have the work done according to directions. This greatly puzzled the teacher, and she asked me to explain it. I gave as an explanation the fact that these two small boys had enjoyed better pedagogical advantages than the others. But the teacher thought this im-

possible, as the smaller one had been to school only one year, and that in a little log cabin up in the hills. But when I called her attention to the fact that these boys had lived on a farm where they had been taught to assume responsibility and to do things, she agreed with my explanation.

I believe that it is the pedagogical value of farm work and the chance of placing responsibility on the child that has more than anything else to do with the development of efficiency and character in farm children, and this accounts for the fact that 29 per cent. of our population on the farms furnishes 70 per cent. of the efficient men in this country.

We have much yet to do before we understand the whole of this question. I believe, however, it is possible to outline a course which shall deal directly with the industries of our people and which will not only better fit pupils for their life's work, but will even fit them for college better than the best of our present high schools. We all recognize that because of our ignorance of the real principles involved in training the young mind, a lot of experimenting must be done before we have arrived at a final solution of this important question. The criticism I have to make of our school system is that we have neglected these essential experiments. It is high time that earnest effort be made in this direction.

W. J. Spillman
U. S. Department of Agriculture

THE SIMPLE VS. THE COMPLEX IN SCIENTIFIC THEORIES

There seems to be a growing feeling that our present hypotheses concerning the structure of matter, and its relation to electricity, are becoming unsatisfactory. The reason for this is the increasing complexity of the phenomena, as we see them, and of the corresponding explanations which this involves. This feeling does not seem to be well founded. A former cave dweller, who has been for a few thousand years an inhabitant of some of the regions which Dante has described, would find our modern life an array of very complex phenomena.

He would observe that empty apartment houses attract homeless families. He would learn that this could not be accounted for by Newton's law of gravitation, although gravitational attraction between houses and people certainly does exist. He might feel inclined to give up Newton's law, because it does not explain all attractions. He finally learns that ether waves are involved in this phenomenon. The people must see the house before it can have any attraction for them. He would learn that the architecture of the house really appeals to the minds of these people. Being something of a philosopher, he constructs a mental field of force, which lays hold of the building and its surroundings, and which proceeds from the conscious beings. He is greatly interested in seeing that people appear very much alike, while houses differ very greatly in construction, in material and in mass.

As he has not yet learned anything about electrical and kindred phenomena, our visitor may be excused if he refers to the people as negative electrons or ions, and to empty houses as positive ions. When a house contains families enough, so that it ceases to have any attractions for more, he calls the combination an atom. He observes that more people can be forced into a house already normally filled, but the motive forces must come from some external source.

He finally learns that a family which has been more or less forcibly ionized, and is about to enter a new home, must deliver to its former occupant and owner, the value-equivalent of a certain number of foot-pounds of mechanical work previously done. The value-equivalent of this mechanical work may exist in the form of a certain number of grams of some valuable substance which is actually delivered. The value to be transferred may also exist potentially in the form of credit at a bank. The transfer of this value may then be effected by entries in the books of the bank, which transfer credits from one customer to another.

By the time our visitor has learned all these well-known things, it would appear that he

should not be greatly alarmed at present developments concerning electrical phenomena.

We know that molecules on the sun are in constant wireless communication with molecules on the earth. We can partially interrupt this communication by interposing a screen having a diameter of a centimeter or two. The molecules within the shadow now receive impulses transmitted to them by those outside of the shadow.

Here we have an action which is sufficiently amazing. Any explanation which we might make of it could not involve anything more wonderful than the action itself.

After we admit the existence of matter and of electrical phenomena, as we now know them, why may we not assent to the proposition that all atoms of matter are composed of positive and negative electricity or of positive and negative ions? This is essentially Franklin's hypothesis, deprived of its occult features, by reason of what has since been learned. The conductors in a power service are then aggregations of positive ions, or of positive electricity. The negative ions, or, as Franklin would have stated it, the electrical fluid, flows through what we now call the positive ions. Their rhythmical transfer from atom to atom accounts for the Joule effect. In addition we may have conditions which involve an actual and sudden transfer of kinetic energy from the moving negative ions to the positive ions. Such a case we have in the electric arc, which seems to me to be mainly a Thomson effect.

It is now established that the positive and negative discharges, which Wheatstone examined with the revolving mirror, are in the nature of compression and rarefaction waves. They are waves in Franklin's fluid. The negative terminal of any battery or dynamo is the compression terminal. From this terminal Franklin's fluid flows.

The writer has obtained photographs of the Wheatstone sparks and Wheatstone's conclusions concerning direction of propagation of the discharges from the terminals have been fully verified.

FRANCIS E. NIPHER

SCIENTIFIC BOOKS

Research in China. In three Volumes and Atlas. Vol. I., Part I. *Descriptive—Topography and Geology.* By BAILEY WILLIS, ELIOT BLACKWELDER and R. H. SARGENT. 4to, pp. xiv + 353 + index. Pls. LI.; figs. 65. 1907. Vol. II. *Systematic Geology.* By BAILEY WILLIS. 4to, pp. v + 133 + index. Pls. VIII. July, 1907. Published by the Carnegie Institution of Washington.

These admirably written and illustrated volumes should be read by all scientists interested in the geology of Asia and also by those interested in the larger problems of diastrophism and geologic history. The first and larger volume will be used more especially as a work of reference for details of Chinese geology; the second volume treats the same material in a condensed and systematic manner, following the course of geologic history and covering to some extent the whole of eastern Asia. Applying throughout the recently developed principles of diastrophism and physiography, a field of research in which the senior author has previously done distinguished work, these volumes mark a distinct advance over the previous comprehensive treatises dealing with this region, von Richthofen's "China" and Suess's "The Face of the Earth." The atlas, by the incorporation of Chinese characters, has been made readily available to the Chinese, and in the modern educative awakening of China such a publication dealing with that portion of the world may be of material aid in stimulating an interest in the earth sciences. It must not be thought, however, with national self complacency that the general educative effect need be restricted to China. The photographs and descriptions of certain districts bring home the desolation which may result from reckless deforestation, with the consequent sweeping of soils from the hillsides and burial of valley alluvium beneath sand and gravel. This is a lesson the American people still need to learn and the material has already been utilized by the *Outlook* and the *National Geographic Magazine.*

The route of the expedition lay first into the Shantung peninsula, thence from Peking southwestward through north central China

to the Yang-tzi-kiang. In so far as the survey was necessarily rapid it partook of the nature of a reconnaissance and was restricted to type areas and to limited widths of territory, but it was of a character greatly superior to most reconnaissances in that the topography and geology within these limits were accurately mapped and comprehensively studied. Future work, therefore, needs simply to extend what has been already so well begun.

A brief summary is not included in the publication and a review may, in passing, mention the prominent features of the geologic history as set forth in the second volume. The Archean is restricted by the author to the metamorphic schists and gneisses of indeterminate character associated with a large proportion of metamorphosed igneous rocks, which by their intricate structure and inferior position to the oldest pre-Cambrian recognizable sediments are marked as belonging to a distinct and older system. The overlying Proterozoic was chiefly studied in the Wu-Tai-Shan and is divided into two systems, the eo- and neo-Proterozoic, the local Chinese names being omitted in this review. The eo-Proterozoic embraces three series separated by two unconformities.

Von Richthofen placed this system in the Huronian, using the latter term, as was commonly done thirty years ago, to suggest pre-Paleozoic rocks of green color. He did so with reserve, however, and the stricter usage of the term as it is now adopted does not permit us to maintain an exact correlation.

Willis points out, however, the strong similarities of these three series to the three Huronian series of the Lake Superior region and Van Hise has more recently compared them with still other formations of other regions similar in lithologic character and age relations. As Willis states:

The general relations to the Archean and neo-Proterozoic are similar in both continents, and the effects may well have been due to a general terrestrial cause which became active at about the same time, in regions remote from one another.

Between the eo- and neo-Proterozoic occurs a stratigraphic break of the first order, indicated both by a great unconformity and by the folding and metamorphism of the lower system which are absent from the upper. The little altered, slightly slaty beds of the neo-Proterozoic resemble the Paleozoic above far more than the eo-Proterozoic below. At least 10,000 feet of slates, limestones and quartzites are embraced in this system. After a period of diastrophism the wide-spread land surface was reduced to a nearly perfect plain over which finally passed in places the Cambro-Ordovician sea. This pre-Paleozoic peneplanation was observed over a stretch of a thousand miles and is a feature of southeastern Asia.

The fact that Asia at the opening of the Paleozoic era was a featureless continent has important bearings. It limits the antiquity of mountain ranges, some of which have been discussed by eminent writers as of pre-Cambrian date, as elevations which have survived since that remote time; and it affords a basis of inference regarding a cycle of inactivity, which was common to other continents as well.

The marine invasion which initiated the Paleozoic sedimentation began in the late Lower Cambrian and gave rise to the Sinian group, extending to the Middle Ordovician. In central China the Sinian is composed of limestone, apparently to its very base, but in north China the characteristic strata of the Lower Sinian are red deposits. In south China, latitude 31° north, near the base of the Sinian and conformably interbedded between a quartzite below and marine limestone above occurs the bed of tillite which has attracted so much attention on account of the profound significance of this early glaciation near the level of the sea.

The Lower Ordovician strata are overlain by Upper Carboniferous, but without discordance of dip, implying prolonged quiet with most of the continental surface lying near sea level. The Carboniferous is characterized by marine deposits in the south, by continental deposits in the north. The transition to the Mesozoic is not marked by a sharp division plane, but by shrinkage of the seas and an increase in the proportion of continental deposits. At the same time Permo-Mesozoic diastrophism was pronounced and the present

structure lines of Asia were largely established. By the Cretaceous, however, Asia was again a low and featureless continent.

The Cenozoic history is one of erosion and land deposit. The Cretaceous peneplain conditions were continued at least in southern Asia through the Eocene and Oligocene and well into the Miocene, when occurred the epoch of mid-Tertiary compression resulting in folding. Since then there have been extreme effects of vertical warping unaccompanied by folding and chiefly of Pleistocene age. The evidence of the latter is largely physiographic and indicates "one of the most remarkable diastrophic movements of which we have knowledge." The Neocene and Pleistocene warping and faulting are believed to have produced differences of elevation exceeding 20,000 feet. Davis and Willis are thus in accord and stand in opposition to the earlier views of European geologists, in that these American investigators hold that the elevations due to Permo-Mesozoic folding or older epochs of diastrophism were long since planed away by erosion and are not the causes of the present relief. These views, developed first in America, are thus made of circumterrestrial application and may be regarded as the great contribution of physiography to geologic theory.

The paleogeographic maps are a feature of this report, as is also the map showing the results of the recent diastrophism.

In the final chapter Willis considers the bearing of the previous facts and conclusions upon the problem of the continental structure of Asia. No adequate outline of this chapter can here be presented. In brief, however, he finds that the continent may be resolved into positive and negative elements, the former areas tending to stand high, the latter tending to stand low. These tendencies are latent during comparatively long periods of quiet and resultant peneplanation, but become operative during epochs of diastrophism. The compressive movements, on the other hand, have pressed and welded the positive elements together, the axial directions of folding representing the compression of the negative zones lying between.

The cause of the diastrophism Willis ascribes to differences in specific gravity, restricted according to Hayford's determination to the outer hundred miles of the earth's body; the vertical movements being chiefly due to isostatic readjustment between the several continental elements, the compressive movements being due to the tendency of the heavier oceanic segments of the earth to spread and underthrust the outer portions of the whole continental mass.

For more than a third of a century the incompetency of secular cooling of the outer crust to account for diastrophism has been pointed out,[1] though it still finds credit in many text-books. Chamberlin, recognizing this, has constructed a hypothesis by which periodic compressive movements are ascribed to a shrinkage of the centrosphere and not the lithosphere. Willis goes still farther and obviates the necessity of postulating shrinkage of either the inner or outer earth. His hypothesis thus belongs to that group to which O. Fisher and Dutton have previously contributed.

This must be regarded as a most suggestive working hypothesis, opening the field still wider to investigation, and may serve to destroy still more the false confidence regarding the cause of crustal movements which was felt by geologists of a previous generation, owing to the narrowly limited hypotheses then in vogue.

The hypothesis advanced by Willis is an extension of that proposed by Dutton, who ascribed folding to that subcrustal horizontal creep from the low toward the high elements which is necessary to isostatically restore the initial elevation of the high and the initial depression of the low.[2]

In the form in which Dutton stated the hypothesis it appears insufficient, since the

[1] C. E. Dutton, "A Criticism upon the Contractional Hypothesis," *Amer. Jour. Sci.*, Third Series, Vol. VIII., pp. 113–123, 1874.

[2] C. E. Dutton, "On Some of the Greater Problems of Physical Geology," *Bulletin of the Philosophical Society of Washington*, Vol. XI., pp. 51–64, 1889.

horizontal movement shown by folding seems far in excess of the subcrustal creep in the outer fifty or hundred miles of the earth's crust needed to restore the isostatic adjustment between the regions on the two sides of the zone of folding. Furthermore, the vertical readjustments which take place in epeirogenic movements are not simultaneous in origin with the horizontal movements.

Somewhat similar difficulties seem to face the larger hypothesis of Willis in which continental and oceanic segments are concerned rather than adjacent geanticlines and geosynclines. The average continental surface stands about three miles above the average ocean bottom, owing to the lighter subcontinental matter. The isostatic compensation, as Hayford has shown, is complete at a distance of about seventy to a hundred miles from the surfaces. A column of matter on the edge of an oceanic segment and extending to this depth will consequently have its top pressed seaward by a pressure due to the greater height of the continental mass, a pressure resisted by the rigidity of the surface of the oceanic segment. The foot of the column, however, will not be strained in either direction, since the weights of the continental and oceanic segments at this depth are equal. Any intermediate point in the column will be pressed seaward with an intermediate pressure.

The initial cause of that horizontal movement which is due to isostatic adjustment on the continental margins would, therefore, be an outward spreading of the continental margin by flowage and normal faulting. The surface being lowered by this means, the subcontinental pressures would be lessened and a landward movement of the lower zone of the oceanic segment would in turn tend to take place, restoring in this manner a part of the initial height. It is difficult to see, however, how compression of the continental surface could ever occur as a result from this spreading except for local and minor adjustments, since the flowing outward of the surface is the operating cause. In so far as sediment from the continents is deposited on the bottom of the oceanic segments, however, and the surfaces of the two are brought toward a common level, the tendency of the top of the continental segments to spread outward will be checked and a tendency for the lower part of the oceanic segment to underthrust the land will arise. But the greater part of terrigenous sediments have been deposited within continental geosynclines, or upon the lower continental elements, or as submarine deltas building slightly outward the continental shelves. The isostatic readjustment should, therefore, be largely between the high and low continental elements and it is not clear that sedimentation could account in any large measure for such a crowding together of the continental elements by pressure from the oceanic segments as the structure of Asia seems to suggest. Furthermore, Willis has shown that the present great relief of Asia is the result of a very recent movement unconnected with the Permo-Mesozoic folding and but partly originating in the mid-Tertiary period of orogenic activity. It seems best, therefore, to consider that vertical movements, bringing about isostatic adjustment, are but indirectly connected with the great compressive movements, following after them to a greater extent than accompanying them; due to a seeking for an equilibrium destroyed on the one hand by erosion and sedimentation, on the other by changes of specific gravity from within, induced partly by the previous horizontal compression. Horizontal compressive movements, on the other hand, characterized by their large amount and brief duration and separated by relatively long periods of quiet, seem to have found as yet no better explanation than that advanced by Chamberlin, as due to a progressive shrinkage of the entire central portion of the earth, resisted by the rigidity of an outer unshrinking zone many hundred miles in thickness. This gives the necessary mechanism for the gradual storage of compressive stress and its periodic discharge by yielding of the outer zone, a yielding characterized by the mashing of geosynclines and other lines of weakness in the outer shell, and the underthrusting of the continental surfaces by the lower and structurally stronger oceanic segments.

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Principles of Breeding. A treatise on thremmatology, or the principles and practises involved in the economic improvement of domesticated animals and plants. By E. DAVENPORT, M.Agr., LL.D., with appendix by H. L. RIETZ, Ph.D. Boston, Ginn & Co. 1907. Pp. xiii + 727.

It is likely that most writers will follow Bateson in using the broader term "genetics" for the subjects covered in this volume, rather than the older and more restricted term "thremmatology," proposed by Lankester, even if for no other reason than ease of pronunciation. However this may be, contemporary investigators seeking the facts of development, variation and heredity are fast accumulating vast quantities of data, past investigations are receiving renewed attention in the light of recent discoveries, and the author who undertakes the often thankless task of compiling a text-book from the varied lines upon which these subjects border, deserves the gratitude of all who are interested in the field. Dr. Davenport brings to his aid fifteen years' experience in presenting these matters in the class-room, and the result is a well-planned and logically developed treatise, written in such clear English that a college student should have little difficulty in seeing the matter with the author's eyes. It may be that all students of genetics will not accept his views upon disputed subjects, for they are the views of an ardent biometrician; it is positive that there will be a difference of opinion as to the relative importance of certain phases of the subject; yet this is the fate of all text-books, particularly those in a new field. There is hardly a doubt but that the statistical method of dealing with problems of heredity is unduly favored; and when the author asserts that "it is the only reliable method of attacking problems in transmission," cytologists and investigators using pedigree culture methods will lend their approbation only so far as to admit that a knowledge of the theory of statistics is a valuable *adjunct* to any line of work. On the other hand, the method of handling the older debated questions of general biology—acquired characters, etc.,—is eminently fair and equitable.

The book is divided into four parts: in the first three, of increasing length, are discussed the kinds of variation, the causes of variation, and the transmission of characters, while the much shorter fourth part is devoted to practical problems. In a short appendix Dr. Rietz gives an excellent introduction to the theory of probabilities. Additional literature is cited at the end of each chapter, which, in the hands of a teacher familiar with all branches of the subject, would be a valuable basis from which to make selected lists for collateral reading. Unfortunately the classics cited are not distinguished from absolutely valueless articles, and such extended lists might thereby become rather more of a hindrance than a help. The originals are cited only when in English; the foreign work, which forms a large portion of the literature in genetics, is therefore noticed only in the form of English abstracts.

After an introductory chapter on the general nature of variability, variation is treated under the heads morphological, substantive, meristic, functional and mutational. The discussion under the first two heads, variations in size and quality, are quite short. We miss any consideration of the facts relating to the difference between mere bigness due to nutrition and inherited size due to gametic structure, which from its importance to the breeder we might reasonably expect. More extended treatment is given to the third type, the examples and text figures being drawn almost wholly from Bateson. Under functional or physiological variation, however, we are indebted to the author for a wealth of new illustrations, many of which are from experiments with beef and dairy cattle and with maize, that have never before been published. Under mutations the author gives to the reader the same impression (and the reviewer believes this time unintentionally) that has caused, and is still causing, false impressions among out and out Darwinians as to the true con-

ception of a mutation. All opponents and many adherents of de Vries seem to be able to conceive a mutation only as the addition or loss of a complete character and therefore a wide jump. That such a change sometimes takes place, the mutationist believes, and so also does the Darwinian (or at least so also did Darwin), but by far the larger number of mutations are quantitative changes in characters already possessed, *i. e.*, simply the production of new modes as centers for linear fluctuation. The difference between fluctuations and mutations is merely in their transmission.

Part II.—Causes of Variations—begins with an admirable non-technical description of cell division, followed by a development of the actual theme, in which are taken up first, internal causes which affect the individual, and second, those which affect the race. One can not help but be struck with the logical manner in which the author disposes of old, popular myths, such as telegony and intrauterine influences, by appealing to the law of error. It is also gratifying to know that he has found by correspondence that practical breeders, for example dog fanciers, seem to be outgrowing their past childlike faith in these things. It is likely that this book will do much toward changing such superstitions as belief in maternal impressions in the next generation of animal breeders. Modern biometry as based on the theory of probability seems to the reviewer to have its greatest value to practical breeders in showing how illogical it is to consider isolated cases as proofs of a biological principle, and considerable emphasis is given by the author to this point. It is hardly likely that many present-day farmers will study thoroughly so bulky and technical a volume, although the author hopes to reach them, but their sons who have had some training in genetics in our agricultural colleges will be given a broader and more scientific point of view.

A large portion of the remainder of Part II. is devoted to external causes of variation. This portion is almost wholly an abstract of C. B. Davenport's "Experimental Morphology." Then, as a transitory introduction to Part III. on "Transmission," follows a very judicial treatment of the inheritance of acquired characters. Here, again, the theory of probability is utilized to show that instances of apparent transmission of somatic modifications are, at least, doubtful—a judgment which the most ardent Lamarckian could hardly question.

A considerable percentage of the remainder of the part is devoted to pure biometry which the author believes to be the coming method for attacking genetic problems. The elements of biometry are explained with greater clearness than in any other English publication, and as such are to be highly recommended. The elaboration of the results of Karl Pearson and his school, however, shows too great a trust in Pearson's lame biology.

It will be exceedingly unfortunate if there is a promulgation of this idea of certain biometricians, namely, that valuable biological conclusions can be drawn where there have been no biological premises, by the mere fact of complex, mathematical treatment. As an example of a biometrical explanation which explains nothing the following may be cited (p. 537):

> The principal function of selection, therefore, is to *alter the type, not to reduce variability*, and the facts here cited show the inherent impossibility of "fixing" the type in the sense that individuals will not depart from it. But, on the other hand, the same principle assures us that, however much we improve by shifting the type, there always remains sufficient variability for further selection, *and so long as variability remains there is hope and possibility for still further improvement.*[1]

Compare this view with that of Johannsen. (By the way, the epoch-making work of Johannsen on "pure lines" is not mentioned.) The latter considers the variation's curve of a quantitative character of any general population to be made up of numerous family lines. Members of these family lines are true to their own type, their fluctuations being due to nutrition, etc., and not inherited. The rôle of selection, therefore, is to isolate a family

[1] Last clause italicized by E. M. E.

line from a heterogeneous mixture of small types differing gametically among themselves. Here we have a real explanation compatible with the belief that to be inherited variations must have affected the germ cell structurally —a view to which the author apparently adheres.

Mendel's original investigations are briefly discussed by the author, but all of the numerous, recent contributions along this line are left untouched. Of course the immense amount of labor necessary to compile a book of seven hundred pages in a new subject would necessitate the work being actually behind the date of the preface, but one would like to see more notice taken of the many valuable investigations of contemporary biologists. A more extended consideration of late cytological and Mendelian research would have changed materially the author's treatment of atavism, prepotency and the determination of sex.

The work as a whole, however, brings together an enormous number of facts along diverse lines, and, though largely zoological, will undoubtedly prove of great value as a reference basis for a course of lectures on the subject, even if the new facts, which are continually being contributed in such profusion, make it of less value as an ironclad text-book.

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Mushrooms, Edible and Otherwise. By M. E. HARD, M.A. Large octavo. Pp. xii + 609, with 504 half-tone figures from photographs, many of them full-page plates. Distributed by The Ohio Library Co., Columbus, Ohio.

Under the above title Mr. Hard has given us an exceedingly interesting and valuable book upon a subject in which every one is interested, whether he is a botanist or not. The book is intended primarily for the beginner and a chapter including such subjects as, Why Study Mushrooms? Mushrooms and Toadstools, How to Preserve Mushrooms, etc., and An Analytical Key, is written in words so simple and yet so accurate that even the beginning student will gain a ready hold upon the group and will not be encumbered with a load of useless and unscientific data. As the late Dr. Kellerman states in the introduction, "The author does not write for the specially educated few, but for the mass of intelligent people—those who read and study, but who observe more." Thus the work is intended to appeal more especially to the people at large, but there is also much good in it for the college student of mycology. The generic and specific descriptions, and the great range of forms depicted in word and picture, are so nicely worked out that the book is one of the very best of the American publications of its kind. Without doubt this is the finest and most carefully arranged set of half-tone figures of American Agarics to be found in a single book.

A little more than one half (349 pages) of the book is devoted to the Agarics, the remainder being divided between the Polyporaceæ, Hydnaceæ, Phelephoraceæ, Clavariaceæ, Tremellini, Gasteromycetes, Ascomycetes, and a chapter each on the Myxomycetes, Recipes for Cooking Mushrooms, and How to Grow Mushrooms. These chapters are characterized by the same interesting style and excellent illustrations.

The author is determined that every one shall come to know mushrooms, first from the practical side to be able to identify the edible ones, and finally to know them from a more scientific standpoint, and then to be led to the broader study of mycology as a whole. The student of this book will unconsciously be led along this very path. As one turns the pages of the book he is delighted almost beyond expression, and he feels that Mr. Hard has rendered a great service to science in general and to mycology in particular in giving us this excellent work.

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SPECIAL ARTICLES

NOTES ON THE FIRST GENERATION HYBRID OF ŒNOTHERA LATA ♀ × O. GIGAS ♂

DURING the summer of 1907 three offspring of *Oenothera lata* ♀ × *O. gigas* ♂ were reared to maturity in the garden at the Station for

Experimental Evolution and observations upon the somatic chromosomes of these plants were embodied in a report read at the Seventh International Zoological Congress.

The peculiar combination of parental vegetative characters in each of these hybrids, associated with a certain fixed number of somatic chromosomes, suggested the desirability of repeating the cross upon a much larger scale in hopes of throwing some light upon the behavior of chromosomes in inheritance and of determining, if possible, whether number, size and shape of chromosomes are regularly associated with the inheritance of certain definite external characters.

In a previous note *O. gigas* was reported to have double the number of chromosomes found in *O. lamarckiana,* with evidence to suggest that the number may vary within a limited range among individuals of the species.[1] Gates[2] later sustained the count of 28 for *gigas* from observations of the germ-cells. In an earlier paper he reported 14 chromosomes for *lata.*[3] The few individuals of this species which I have examined have given 14 and 15 chromosomes with considerable, though not conclusive, evidence that a single plant had 16.[4] The number for each individual however remained constant.

The striking differences in the number of chromosomes of *lata* and *gigas,* associated with marked differences in external characters, caused the progeny of a cross between individuals of these two species to become a subject of particular interest. Seeds for the first generation offspring of *O. lata* ♀ × *O. gigas* ♂ were secured from guarded pollinations through the kindness of Dr. G. H. Shull. The hybrids arising therefrom were the progeny of a single pair of parents; the pistil parent in this case being a mutant which arose from a culture of pure-bred *lamarckiana* and the pollen parent a pure-bred *gigas.* Seventy-seven young rosettes were transferred to the experimental garden early in May, fixations having previously been made of the root tips of 50 of this number for the study of somatic chromosomes.

By sowing seeds in the greenhouse early in February and transplanting rosettes to the garden as soon as danger of frost is past, *lata,* like *lamarckiana* and others, may readily be brought to flower the first season. *Gigas,* on the contrary, is strongly biennial and even when subjected to the same conditions as *lata* from seed-sowing to maturity only a small percentage can be expected to flower and ripen seeds the first season. Consequently, the fact that 44 of these hybrids were annuals is of considerable apparent significance. It is, however, unsafe to conclude that this is a manifestation of an hereditary character, inasmuch as the majority of those remaining in the rosette stage were subjected to slightly different environmental conditions, having been transplanted to the garden 9 days later than the majority of those which proved to be annuals, and transferred to somewhat richer soil. Designating the two plots as east and west gardens, 47 young rosettes were transplanted to the former May 1 and 3 on May 10. Of the first lot, 37 came to flower during the season, 3 died and 7 have gone into the winter as rosettes.

Twenty-seven rosettes were transferred to the west garden May 10, of which 5 came to flower during the season, though very much later than the majority of those of the same class in the east garden.

The somatic chromosomes of 40 of these hybrids (25 of which were annuals) have been carefully studied and the remaining 10 will be included in the final publication to appear shortly. To insure accuracy of chromosome counts, none was considered conclusive unless sustained by 10 or more perfectly clear figures distributed through 2 or

[1] "A Preliminary Note on the Chromosomes of *Œnothera lamarckiana* and One of its Mutants, *O. gigas*," Science, N. S., 26: 151–2, August 2, 1907.

[2] "The Chromosomes of *Œnothera*," Science, N. S., 27: 193–5, January 31, 1908.

[3] "Pollen Development in Hybrids of *Œnothera lata* × *O. lamarckiana* and its Relation to Mutation," *Bot. Gazette,* 43: 81–115, 1907.

[4] "Chromosomes of the Somatic Cells of the *Œnothera*," Science, N. S., 27: 335, February 28, 1908.

more (usually 3 to 6) separate fixations from each plant. In every case but one, referred to later, the number remained constant for each individual throughout the several fixations. Corroborative evidence was also secured in a number of the exceptional forms by a study of tapetal cells. Hundreds of figures were carefully examined to determine whether individuality in size and shape of chromosomes could be recognized, but no evidence whatever was secured to demonstrate that any such differences exist.

In the majority of these hybrids the exact number of somatic chromosomes has been determined with certainty; but owing to the fact that a few of the intermediates and several of the *gigas*-like hybrids yet require the study of more sections to settle the question of one or two chromosomes more or less, it will be necessary for the present to group them merely under the heads of *lata*, *gigas* and intermediate. The identifications are based both on chromosomal and vegetative characters. While these groupings are sufficient in the main for all classes, II. and III. can well be further subdivided with respect to external characters.

CLASS I., *lata*, is represented by 2 individuals appearing as true *lata* in every point, indistinguishable from *lata* mutant from earliest seedling stage, and having *lata* number of chromosomes—15. Both annuals.

CLASS II., *gigas*, consists of 6 plants having *gigas* number of chromosomes (30 in each case so far definitely counted). Two of the 6 plants were annuals; one resembled *gigas* far more strongly than any other hybrid coming to flower in the garden, yet hardly to be classed as a good typical *gigas*. The second annual resembled the individuals of Class III. in a few, and pure *gigas* in the majority, of its vegetative characters. A peculiar exceptional circumstance is connected with the microscopic study of this plant. Fixations of root-tips, prepared April 3, gave an intermediate number of chromosomes. Another dated April 11 showed the *gigas* number with equal clearness, while a third was poorly fixed and gave no hint to settle the question. A fourth fixation of tapetal cells was made in August and clearly demonstrated the higher number. It therefore seems probable that the first fixation was taken from a member of Class III., and the confusion arose from an error in labeling. It is upon the basis of this conclusion that I have included this plant within Class II. rather than III.

The third plant under this head (biennial) was characterized in early seedling and rosette stages by whitish markings, so conspicuous in *albida* at corresponding stages of development. It differed markedly from the latter, however, in shape of leaf. The three remaining biennials differ considerably from one another, but equally pronounced differences have been noted among individuals of pure *gigas*. The members of this class, however, form the least homogeneous group of the three with respect to external characters.

CLASS III. is represented by 32 individuals, 21 of which were annuals. A portion of these had 22, others 23 and some possibly 21 chromosomes, although evidence is not yet complete in regard to the last. With respect to vegetative characters, the plants of this group fall readily into 3 subdivisions:

1. Consists of a single individual, remarkable for its narrow leaved, *gigas* type of foliage, utterly unlike that of *lata*. A single lateral flowering branch produced a few buds and flowers which were noted as "intermediate."

2. Is composed of those individuals which may be classed as true intermediates and includes 12 of the 21 annuals of Class III. The main features characteristic of this group are as follows: resembled *lata* in imperfect unfolding of petals, scarcity of pollen produced, sterility of pollen and shape of first buds; resembled *gigas* in size of corolla (with several exceptions), and various parts of flower, in red tinting of sepals (particularly in latter part of the season), and in general vigor of the plant.

3. Is in many respects the most interesting of all. It is composed of those individuals of class III. that have long slender buds, flowers with smooth petals and yield a moderate abundance of pollen. It may again be properly subdivided into *a* and *b*; the former consisting of three plants attaining the height of

lamarckiana and being indistinguishable from it in manner of branching and large number of flowers produced. A fourth member of this group bloomed late in the season and did not attain its full stature. The buds of these peculiar hybrids might have been classed as stout *lamarckiana* or slender *gigas*. The sepals remained conspicuously yellow, attaining near the end of the season a faint tint of red, like extracted *latas* of this cross. The foliage resembled *gigas*.

The second half of this group consisted of four plants somewhat resembling the first in size and branching habits but, in three of the four individuals, distinguished from it by the deep red color of the sepals—strikingly resembling *rubrinervis* in this regard. The fourth plant had less deeply colored sepals and possibly should be placed in a subdivision of its own.

The appearance among the offspring of *O. lata* × *O. gigas* of plants with pronounced *lamarckiana* characters is puzzling. The combination of these with equally pronounced *gigas* characters, further associated with the intermediate number of chromosomes, precludes the possibility of the pistil parent having been accidentally fertilized by *lamarckiana* pollen. MacDougal[5] succeeded in fertilizing *lata* with its own pollen for the first time on record, and obtained seed which "gave rise to a progeny which showed only the constitutents usually found in a progeny of this plant when fertilized by *lamarckiana*."

Study of the pollen of these hybrids is as yet in the initial stages, but some interesting observations have already been made.

Pollen grains of *O. lamarckiana, O. lata, O. nanella, O. rubrinervis* and *O. cruciata* are, so far as I have observed from the cultures growing at the station this summer, characteristically 3-lobed as figured by Gray[6] for *Œnothera*. Limiting observations to the first two forms mentioned, ordinarily about 1 in 1,000 grains has been found to have 4 or more lobes, although as high as 15 per cent. has been observed in normal, typical individuals. Seven representatives of pure *gigas* were examined and the 3-lobed grain was found to occur as rarely in this species as the 4 and 4+ grains in *lamarckiana*. Four-lobed grains prevailed for most individuals of *gigas*, although these were commonly found mixed with 5-, 6-, 7- and even 8-lobed grains, usually decreasing in frequency with the increase in the number of lobes. A further interesting point brought out was the fact that certain individuals showed these extra lobes in all stages.

The study of the pollen of the hybrid progeny of *O. lata* × *O. gigas* was therefore of absorbing interest.

Class I. (two extracted *latas*) showed 3-lobed pollen with an exceptional extra-lobed grain, as is characteristic for a *lata* mutant.

Class II., composed of two adults with *gigas* number of chromosomes gave each 4 and 4+ grains with an exceptional 3-lobed individual as is characteristic for pure *gigas*.

Class III. (hybrid number of chromosomes), pollen of seven individuals studied each gave a mixture of 3- and extra-lobed grains. The proportions have not yet been ascertained, but it is clear that the former are usually considerably in excess of the latter.

The sterility of *lata* is due not only to the scarcity of pollen produced, but to the large percentage of bad grains. The amount yielded by any form was found to vary with the individual, with the flower of the individual, and with the anther of the flower. Even the most fertile forms produce a surprisingly large percentage of bad pollen, and some of the above hybrids, notably certain members of Class III., subdivision 3, have been found to have as high as 90 per cent., although pollen was produced in moderate abundance. Inasmuch as *lata* yields but very little pollen, mostly bad, and *gigas*, while producing a considerably larger quantity, has in most instances a low percentage of good grains, it is not at all surprising that it was utterly impossible to artificially self-pollinate the majority of these

[5] "Mutations, Variations and Relationship of the *Œnothera*," by D. T. MacDougal, A. M. Vail and G. H. Shull. The Carnegie Institution of Washington, Papers of Station for Experimental Evolution No. 9.

[6] Gray's "Lessons and Manual of Botany," revised edition, 103, fig. 316.

hybrids, although attempts were persistently repeated throughout the summer. However, a few seeds were obtained from individuals having respectively *lata, gigas,* and intermediate number of chromosomes and the plants derived from these will form the chief subject of study for the coming year.

To summarize briefly:

The first generation offspring of *O. lata* ♀ × *O. gigas* ♂ fall into three main groups with respect to external characters and number of chromosomes; namely, *lata, gigas*-like and intermediate. Considering external characters only, the latter two should be further divided and subdivided.

Numbers of chromosomes are closely associated with external characters in the first and last, and probably also in the second group.

Pollen grains of two parental forms differ in number of lobes and these are inherited.

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December 7, 1908

MUCOR CULTURES

IN the study of the Mucoraceae for several years, some interesting facts concerning the development or rather the non-development of zygospores were observed. The experiments were made with the common *Mucor stolonifer* Ehrenberg. The media used were bread, pumpkin, orange, cornmeal, decoction of horse manure with gelatine, Pasteur's solution with gelatine, Hamaker culture medium.[1] The cultures were made with sterilized and unsterilized media. The spores for inoculation were taken from plants grown in the laboratory, from specimens collected for the herbarium, and from specimens sent to us by friends. In one thousand cultures not one zygospore was discovered.

In addition to the cultures, five hundred specimens of this species found growing spontaneously in different places were also examined but not one zygospore was observed.

Besides these experiments, many cultures were made and many specimens examined, a record of the exact number of which, however, was not kept. It is a conservative estimate to say that five hundred observations of this kind were made. This makes a grand total of two thousand observations without a single zygospore.

Experiments were also made to determine the development of this Mucor under anaerobic conditions. The media used for these experiments were orange, bread and Hamaker culture medium. All were sterilized. In giving the results of these experiments below, the word cornmeal will be used for the Hamaker medium. Cornmeal is the principal constituent of the medium. The material for inoculation was kindly furnished by Dr. Niewland, of Notre Dame University.

Small wide-mouthed bottles were used for the cultures. The medium was placed in the bottles and the bottles then closed with cotton and all sterilized. After inoculation, the bottles were placed into Novi jars and the jars filled with gas. The jars with the bottles were then set aside for observation. The following results were obtained.

In Hydrogen.—On orange, mycelium developed but few sporangiophores, no zygospores; on bread, no development; on cornmeal, no development.

In Nitrogen.—On orange, mycelium and few sporangiophores, no zygospores; on bread, about the same result; on cornmeal, about the same result.

In Carbon Dioxide.—On orange, mycelium well developed but few sporangiophores; on bread, mycelium profusely developed, many sporangiophores, no sporangia, no zygospores; on cornmeal, no development.

It seems that the absence of oxygen is not a necessary condition for the growth of zygospores.

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[1] Hamaker, SCIENCE, XXIII., 710, 1906.

THE BOTANICAL SOCIETY OF AMERICA

A UNION OF THE BOTANICAL SOCIETY OF AMERICA, THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY AND THE AMERICAN MYCOLOGICAL SOCIETY

THE third annual meeting of the federated societies (the fifteenth of the Botanical Society

of America) was held in the Eastern High School, Baltimore, Maryland, December 28, 1908, to January 1, 1909, under the presidency of Professor W. F. Ganong. Over sixty members were in attendance at the meeting, which seemed generally regarded as unusually successful. The arrangements made by the local committee for the American Association concerning rooms, stereopticons, etc., proved entirely adequate and satisfactory.

The officers of the society for 1909 are:

President—Professor Roland Thaxter, Harvard University.

Vice-president—Mr. A. F. Woods, Bureau of Plant Industry.

Treasurer—Dr. Arthur Hollick, New York Botanical Garden.

Secretary—Professor D. S. Johnson, Johns Hopkins University.

Councilors—Professor J. M. Coulter, University of Chicago; Professor Wm. Trelease, Missouri Botanical Garden; Professor F. E. Clements, University of Minnesota.

Five associate members were elected to full membership, and eight botanists were elected to associate membership.

The next annual meeting of the society will be held in conjunction with the American Association for the Advancement of Science.

Important features of the program were the special addresses given on invitation of the council by Professor Roland Baxter, of Harvard University, and Professor J. C. Bose, of Presidency College, Calcutta; the addresses on "Vascular Anatomy," by J. M. Coulter and E. C. Jeffrey; the symposium on "Present Problems in Ecology," with papers by H. C. Cowles, B. E. Livingston, C. H. Shaw, V. M. Spalding and E. N. Transeau; and, finally, the estimates of Darwin's work in botany, given at the Darwin Memorial Session of the society by Wm. Trelease, H. M. Richards and F. E. Clements.

It is planned to publish in full in *The American Naturalist* the addresses on "Vascular Anatomy," on "Plant Ecology," and those given at the Darwin Memorial Session. Reprints of these papers will then be distributed to members of the society.

The scientific session of the society on Thursday morning, December 31, was devoted to the reading of papers which were organized into two programs given simultaneously. Abstracts of these papers follow:

The Structure and Organization of Pediastrum: Professor R. A. Harper, University of Wisconsin. By title.

Illustrations of Some of the Types of Coralline Algæ: Dr. M. A. Howe, New York Botanical Garden.

The speaker exhibited a series of lantern-photographs, illustrating the form, structure and habits of growth of the dominant types among the Corallinaceæ. The specimens selected for photographing were collected chiefly on the shores of Newfoundland, Maine, Florida, Bermuda, the Bahamas, Jamaica and Porto Rico. Certain calcareous Chlorophyceæ, often confused with the Corallinaceæ by the earlier naturalists, were also illustrated. The structure of several genera of unsegmented corallines was exhibited by means of photomicrographs. Of special biological interest were photographs showing corallines growing attached to living corals and indicating competitive struggles for existence between calcareous plants and calcareous animals. The speaker alluded to the wide geographic range of the corallines and to the discovery by the late Professor Kjellman of extensive beds of *Lithothamnion glaciale* off the coasts of Spitzbergen and Nova Zembla, more than twelve degrees north of the Arctic circle. Mention was made, also, of recent investigations tending to show that reef-building and land-formation in certain regions have been due to the growth of calcareous plants fully as much as to the corals.

The Male Gametophyte of Dioon edule: Professor C. J. Chamberlain, University of Chicago.

The staminate cones of *Dioon edule* shed their pollen in September, the male gametophyte at this time consisting of a prothallial cell, a generative cell and a tube cell. The generative cell divides in October, forming a stalk cell and a body cell, and the latter divides in the following spring, giving rise to two sperms. The sperms are formed within two sperm mother cells and swim freely within the mother cells before they escape into the tube cell.

The blepharoplasts are first distinguishable in the body cell and are very probably of nuclear origin. The radiations about the blepharoplasts arise by a transformation of the cytoplasm, but owe much of their subsequent growth to granules of nuclear origin. During the transformation of the blepharoplast into the spiral band, the band is closely connected with the nucleus, both morphologically and physiologically.

The mature sperms not only swim actively by means of cilia, but have an amœboid movement. In escaping from the pollen tube, they may be constricted to less than one fourth their normal

diameter, but readily regain their form. The cilia continue to move even after the sperm has penetrated the egg, but the nucleus soon slips out from the cytoplasmic sheath and moves toward the egg nucleus.

Some details in the transformation of the blepharoplast into the spiral band, as well as details in the origin and development of cilia, are better shown in *Ceratozamia* and will be treated in greater detail in the forthcoming paper on that genus.

Further Studies of Œnotheran Cytology: Dr. R. R. GATES, University of Chicago.

In a recent paper[1] I described the method of chromosome reduction in *Œnothera*, using *O. rubrinervis* and several of the other mutants as types. I have since examined the various stages of reduction in the wild *O. biennis* and in *O. lævifolia*, and the observations confirm in practically every detail the results recorded in that paper. In both of these forms the chromosome number is fourteen, the reduced number being seven.

The essential points in the method of reduction may be briefly stated as follows:

After synapsis a single thick spirem is finally formed, which breaks into a chain of fourteen chromosomes lying mostly attached end to end. These do not always pair with each other, but frequently lie unpaired on the spindle. In the heterotypic mitosis half of them pass to each pole. Each divides during the later stages of this mitosis, and the halves are separated by the homotypic mitosis. The first mitosis thus separates whole chromosomes and the second mitosis the (probably) longitudinal halves of these. The chromosomes become so nearly globular that the direction of this split is not easily determined.

On account of the weakness of the attraction between homologous chromosomes at the time of pairing, many of them lie unpaired on the heterotypic spindle; and this allows of occasional irregularities in their distribution. Such irregularities provide a possible basis for the origin of mutants having the same number of chromosomes but lacking certain groups of characters, provided, of course, that the chromosomes are qualitatively different.

The Type of the Genus Cactus: Dr. J. N. ROSE, U. S. National Museum.

Edaphic Conditions in Local Peat Bogs: Dr. G. P. BURNS, University of Michigan.

Beginning with the open water, the plant societies usually found in the peat bogs near Ann Arbor are the aquatic, bog-sedge, bog-shrub, tamarack, maple-poplar and willow or marginal societies. A study was made of the distribution of these societies at different lakes and records were made of the variations in the edaphic factors influencing the different societies.

The data obtained indicate quite clearly that the position of the peat deposit is dependent upon the depth of the water and shape of the shore of the original lake and not upon the direction of the prevailing winds, as has been supposed.

Of the edaphic factors, the position of the water-table in the various areas is the most important. This is subject to wide variations. In the summer of 1905, April 24 to August 5, the variation under the different societies was as follows: bog-sedge, 0 cm.; bog-shrub, 17 cm.; tamarack, 31 cm.; willow or marginal society, 95 cm. In these outer areas fungi and bacteria can work to greater depths, changing the nature of the soil and rendering it capable of holding more and more available water, or in other words less xerophytic.

Continuous temperature records also show that the marginal areas are less xerophytic than those nearer the open water.

Stomata and Transpiration in Tradescantia zebrina: Dr. B. E. LIVINGSTON, Desert Botanical Laboratory.

The purpose of this study is to determine as well as possible to what extent the stomata are influential in causing the transpiration rate to be relatively greater by day than by night. By measuring the stomatal pores and calculating the relative diffusion capacities for night and day, it is found that this capacity in the daytime is about 2.6 times as great as in the night. The influence of the evaporating power of the air in this connection varies, of course, with weather conditions. The greatest difference observed shows an evaporating power for the day of 6 times that of the night. The smallest difference shows a ratio of 1.92. An attempt is made to calculate the transpiration ratio (day to night) by multiplying the evaporation ratio by the ratio of diffusion capacity. The result of this apparently shows that with direct sunlight the calculated transpiration rate for the day is too low, while with diffuse light it is too high. An average of nine tests with diffuse light shows the actual transpiration ratio to be 0.76 of the calculated, but individual tests showed a close approximation.

The conclusion is that, with diffuse light, the

[1] "A Study of Reduction in *Œnothera rubrinervis*," *Bot. Gaz.*, 46, 1–34, 1908.

variation in the size of the stomatal pores in *Tradescantia zebrina* (with the resulting variation in diffusion capacity) is amply great enough to explain that portion of the daily rise in transpiration rate which is not dependent upon the variation in the evaporating power of the air. With direct sunlight it appears that the stomatal variation is not large enough to explain this.

The Vegetation of Northern Zacatecas, Mexico: Professor F. E. Lloyd, Alabama Polytechnic Institute.

A general comparison between the vegetation of the region indicated in the caption with that of other desert regions, more especially with that of the vicinity of Tucson, Ariz., in which the greater general density of the vegetation of the Zacatecas desert is pointed out, and an attempt is made to explain the difference upon the grounds of diversity in meteorological conditions as bearing on soil-moisture and evaporation.

The extended account embraces a year's observations of the meteorology, the topography and soils of an area of 2,000,000 acres, a somewhat detailed account of the plants and their distribution as related to the topography, together with observations upon the seasonal changes, and the adaptational characters in the vegetation which appear to be correlated with them.

The Presence and Absence Hypothesis: Dr. G. H. Shull, Station for Experimental Evolution.

In explaining the behavior of what are now called Mendelian hybrids, Mendel assumed that pairs of antagonistic characters are represented by pairs of internal units, one member of each such pair of units coming from the one parent, the other from the other parent, and both existing side by side in the heterozygotes. De Vries laid great stress upon this conception in distinguishing between "varieties" and "species." This idea is perhaps yet the most commonly held, though it has recently become common to describe a Mendelian "pair" of characters in the terms of the presence and absence of a *single* character. There is no evidence of the existence of a pair of internal units or "allelomorphs" and the phenomena of incomplete dominance, reversal of dominance, etc., can be simply explained by the assumption that there is no paired condition of internal units. The dominance of the absence of a character over its presence is readily explained by analogy with many common chemical reactions, and while it may be assumed, as has been done by Bateson and Davenport, that what appears to be *absence* of a character may really be the *presence* of an inhibiting factor, this is not a necessary assumption. It can be shown that absence of an internal unit may be expected occasionally to dominate its presence.

Cultures of Uredineæ in 1908: Professor J. C. Arthur, Purdue University.

For the tenth consecutive season cultures of various species of rusts have been made from both resting or winter spores and active or summer spores. There were 204 collections with resting spores available, of which, however, only 105 collections were brought into germinating condition. Of those which could be made to germinate 248 sowings were made, representing about 44 different species. Of collections with active spores 73 sowings were made, representing about 16 species. The proportion of successful cultures equaled, or possibly exceeded, that of previous seasons. Some of the results of most general interest may be mentioned. For the first time in America the early or brown rust on rye was grown on *Anchusa*, being sown in July, and the similar rust on wheat failed to germinate so soon after maturity, seemingly settling the much-discussed identity of the so-called *Puccinia dispersa* of Europe and of America. Many trials with the rust on timothy, *P. phleipratensis*, failed to infect barberry plants, this agreeing with European studies. Telial connections were established for *Æcidium macrosporum* on *Smilax*, and the æcia on *Ranunculus*, *Cymbalaria* and *Aquilegia* sp. An unusually large addition to current information was secured regarding species of *Gymnosporangium*. The life-cycle was demonstrated for the first time for one species from the southern states, one species from the northern states and one species from the western states beyond the Rocky Mountains.

Dichotocladium, a New Genus of the Mucoriniæ: Professor A. F. Blakeslee, Connecticut Agricultural College.

The species (*D. stoloniferum*) which forms the type of this genus was found five years ago in Venezuela growing saprophytically on dung. It has the habit of growth of a *Chætocladium*, to which it is undoubtedly most nearly related. It differs from *Chætocladium* primarily in that the fertile branches are dichotomous, not in whorls, and the sterile ends are not bristle pointed.

The genus may be briefly characterized as follows: Vegetative hyphæ stout, distinct, continuous. Fertile hyphæ erect or creeping, stoloniferous, bearing one to several lateral bushy crowns of repeatedly forked hyphæ. Ultimate branches of crown, slender, projecting beyond its surface, or short, terminated by persistent swollen heads upon

which are borne solitary spores. Sexual condition heterothallic.

The Interpretation of pre-Persoonian Names, and their Bearing on the Selection of a Starting Point for Mycological Nomenclature: Dr. E. J. DURAND, Cornell University.

The paper discusses with quotations and examples the difficulties attending the interpretation of the species of pre-Persoonian authors because (1) the species were based entirely on external characters; (2) specific limits are now much more closely drawn than formerly; (3) microscopic characters, then ignored, are now regarded as the most important bases for generic and specific distinction, and (4) they as a rule preserved no specimens by which their names can be definitely determined. It is proposed, therefore, that the date 1753 be abandoned as the beginning of mycological nomenclature and a later one selected, so that these old names may be excluded. The considerations which should have weight in the selection of such a date are then taken up, and a brief history of systematic mycology given, with the discussion of several possible starting points. The conclusion is finally reached that Persoon's "Synopsis Methodica Fungorum," of 1801, be selected for the following reasons:

1. The genera and species described before the time of Persoon should be excluded from consideration because the majority of them can never be definitely and accurately identified.

2. Any publication in the modern period is too recent, the bulk of the systematic work having been done before it began.

3. Its date of publication is early enough to include a great majority of the published names of fungi, and nearly all of those which can be certainly fixed at the present time.

4. Its publication marks the beginning of the second important epoch in mycological history.

5. Its author was the originator of systematic mycology.

6. It can be used as well as any other work as the common point of departure for all groups of fungi.

7. It is a comprehensive work covering all groups of fungi, and summarizes what had been done before its time, so that it bears about the same relation to the classification of fungi that the "Species Plantarum" of Linnæus does to that of vascular plants.

8. Persoon's herbarium is in existence and is available for study, so that most of his names can be fixed with a degree of definiteness impossible for those before his time.

Adaptations in a Desert Lichen Flora: Professor BRUCE FINK, Miami University. By title.

Successful Inoculations with Peridermium: GEORGE GRANT HEDGCOCK, Bureau of Plant Industry.

Studies of the Potato Fungus, Phytophthora infestans: Professor L. R. JONES and Mr. N. J. GIDDINGS, University of Vermont.

Phytophthora infestans has been carried continuously in pure culture in the laboratories of the University of Vermont for four years. Starting with sterile blocks of raw potato, other culture media have been used with varying success, including raw and cooked potato and pumpkin; potato extract media, including juice from raw potato variously handled, potato broth, and broth with agar or gelatin; pumpkin agar; and several synthetic media solidified with agar.

Longevity.—Sealed gelatin cultures seven months old remained alive, but were slow in starting.

Noteworthy Morphological Characters Observed.—Haustoria-like branches in potato tissue as described by Delacroix. Abundant septation in old cultures. Apparent differentiation in some cases into two strains, the one exceeding the other in vegetative vigor. Oogonia-like bodies sparingly produced on certain media, frequent on others.

Concerning Infection and Disease Resistance.—Sporulation may occur in diseased tubers before digging and in storage. Infection occurs usually through eyes, but occasionally through wounds or lenticels. Wide differences occur between varieties (*e. g.*, Early Rose, vs. Irene) as to ease of leaf infection and subsequent rate of spread; leading to conclusion that disease resistance of leaves may reside in mesophyll as well as possibly in epidermal tissues.

Similar differences occur in the rate of development upon sterile blocks cut from the interior of potato tubers, *e. g.*, Ionia seedling *vs.* Irene. This difference is not due to the acid reaction of cell sap.

Artificial Cultures of Phytophthora with Special Reference to Oospores: Dr. G. P. CLINTON, Connecticut Agricultural Experiment Station.

In the 1905 Connecticut Agricultural Experiment Station Report the writer gave results of experiments with artificial cultures of *Phytophthora infestans.* The oospores, which are as yet unknown, did not develop in these. However, the oospores of *Phytophthora phaseoli,* described for the first time, readily developed in the cultures. The past fall specimens of the recently described

Phytophthora thalictri were found, but cultures were not attempted, since the host had no perennial parts from which infected tissue could be taken. However, the oospores, not reported before, were found in the leaves. To account for their absence in the potato mildew, especially in artificial cultures, the writer suggested that these fungi may have distinct sexual mycelia. This is indicated by observations that the antheridia and oogonia of the other two species seem to be borne on separate mycelial threads. Recently the writer again obtained pure growths of the lima bean mildew, from which several hundred cultures have been made in an attempt to solve this problem. Cultures from mycelial growths, possibly mixed, have so far always produced oospores. Petrie dish separation cultures are now being made to get cultures from single spores. If the theory is correct, these should produce no oospores.

Origin and Function of the Peridium of the Rusts: Professor E. W. Olive, South Dakota State College. By title.

Observations on the Relation of Wound Parasites to the Heartwood of the Affected Tree: Dr. P. Spaulding, Bureau of Plant Industry.

While studying various wood-rotting fungi for the past few years there has been noted a very apparent relation of the so-called "wound parasites" to the heartwood of the diseased trees. A very striking instance of this was that of *Fomes ribis* occurring upon sassafras trees. In every case examined this fungus was found attacking the tree only in wounds where the heartwood was exposed by some injury, such as the breaking of a large branch, or the splitting of a branch from the main trunk. *Fomes igniarius*, as studied for the past four years, upon beech, has been found occurring in a similar manner. Hundreds of blazed beech trees have been examined, and in not a single instance was this fungus found growing upon these blazes in the sapwood. On the other hand, it was constantly found at wounds which extended into the heartwood. *Polystictus versicolor*, when attacking the heartwood of catalpa, occurs, growing into the stubs of dead branches. Such observations as have been thus far made upon *Fomes fraxinophilus* when attacking white ash show the same thing to be true, the attack practically always being made through dead stubs. Von Schrenk has also said that *Fomes rimosus* attacks the heartwood of black locust, either by entering through the dead stubs or through insect burrows. The sapwood of black locust is comparatively thin, and it is safe to accept his implied statement that heartwood must be exposed before this fungus attacks its host.

Further Studies of the Anthracnoses: Dr. C. L. Shear and Miss Anna K. Wood, Bureau of Plant Industry.

Twenty-three forms of so-called *Colletotrichum* and *Glœosporium* from the following hosts have been studied since the writers' previous paper was published: 1, *Camellia japonica;* 2, *Caryota rumphii;* 3, *Cinnamomum zeylanicum;* 4, *Citrullus vulgaris;* 5, *Citrus limonum;* 6, *Citrus decumana;* 7, *Citrus aurantium;* 8, *Coffea arabica;* 9, *Costus speciosa;* 10, *Cucurbita maxima;* 11, *Curculigo* sp.; 12, *Eriobotrya japonica;* 13, *Ficus longifolia;* 14, *Kentia* sp.; 15, *Lathyrus odoratus;* 16, *Ligustrum vulgare;* 17, *Maranta lineata;* 18, *Musa sapientum;* 19, *Persea gratissima;* 20, *Phormium tenax;* 21, *Piper macrophylla;* 22, *Pitcairnia corallina;* 23, *Psidium guajava;* 24, *Rubus occidentalis;* 25, *Thea bohea.*

Pure cultures made from conidia from hosts 6, 16, 19, 24 and 25 produced both conidia and ascospores and both these forms of fructification have been found on the host plants also. Cultures from conidia from hosts 3, 20 and 21 have produced both conidia and asci, but no ascogenous fructifications have been found on the host plants themselves. On hosts 1, 2, 5, 7, 8, 9, 11, 12, 13, 17, 22 and 23, both conidia and ascospores have been found. On hosts 4, 10, 14, 15 and 18 only conidia have been found and the cultures from the same hosts have produced only conidia.

Cultures from a single conidium taken from *Persea gratissima* carried through twenty-three generations have shown considerable variation in character of growth and development in different generations. Cultures from a single ascospore from the same source carried through seven generations have been quite uniform. The cultures from conidia usually produced an abundance of acervuli followed by perithecia. The cultures from ascospores produced no acervuli except a few very small ones in the first generation, but scattered conidia and an abundance of perithecia occurred in all. The ascospore cultures still produce conidia and the conidia cultures still produce asci.

No morphological characters either in cultures or under natural conditions have been found to be sufficiently constant to justify the segregation of species except perhaps in the case of the cotton anthracnose. The ripe rot fungus of the grape, *Glœosporium* (*Glomerella*) *rufomaculans*, represents fairly well the essential characters of all.

Cross inoculations from forms on fruits seem to indicate that the fungus may soon adapt itself to a different host and after a few generations develop about as readily on one fruit as another. All are perhaps only slightly specialized physiological forms of one omnivorous species.

A Bacterial Gall of the Daisy and its Relation to Gall Formations on Other Plants: Dr. C. O. TOWNSEND, Bureau of Plant Industry.

In 1904 some Paris daisy plants affected with galls of different sizes were received from a commercial grower of this plant in New Jersey. Work upon the cause of these gall formations and their relation to similar abnormal growths upon other plants was undertaken by the writer in cooperation with Dr. Erwin F. Smith, in charge of the Laboratory of Plant Pathology. Much of the technical work in connection with the problems investigated has been performed by Miss Nellie A. Brown, scientific assistant in the Laboratory of Sugar Beet Investigations.

After repeated efforts an organism was isolated from the galls, which had the ability to induce the formation of new galls upon healthy plants when inoculated into the stems and branches or even into the leaves of healthy daisy plants. From these galls formed by inoculation, the organism has been isolated and the process of inoculation repeated until no doubt remains regarding the cause of the gall formations.

The organism which produces these growths is a short rod, motile, possessing from one to three polar flagella, non-gas forming, and does not cloud bouillon heavily. On agar plate cultures the colonies come up slowly, usually in from three to five days, at a temperature of 25° C. The surface colonies are translucent white, round, with entire margins, smooth and dense. The growth is viscid on agar streak cultures after three days. The organism blues litmus milk, does not liquefy gelatin and does not grow at blood temperature in either agar or bouillon cultures. It will grow slightly at a temperature below 0° C.

The daisy organism will produce galls upon a large number of other plants, including tomato, potato, tobacco, sugar beet, hop, carnation, grape, raspberry, peach and apple. This work has led to the isolation of pathogenic Schizomycetes from the galls of peach, hard gall of apple, hairy root of apple, hop, rose and chestnut. The organisms obtained from the galls of these different plants are cross inoculable and are very similar, if not identical in size, shape, structure and habits of growth on media with the organism from the daisy gall. Pure cultures of these organisms are now under investigation. The abnormal growths produced by inoculation with the organisms obtained from the galls of the plants mentioned are similar in many cases to those produced by the daisy organism upon those plants.

These investigations have left no doubt regarding the cause of the crown gall of the peach and at least some of the gall formations upon the apple and other economic plants.

Variation of Fungi Due to Environment: Professor F. L. STEVENS and Mr. J. G. HALL, North Carolina College of Agriculture and Mechanic Arts.

The effect of different densities of colonies on a plate is reported for five species of fungi, some of which show an entire elimination of pycnidial formation and the production of spores without covering when plates are thickly sown.

The effects of different densities of mycelium upon zone formation are illustrated from *Ascochyta* and *Sclerotinia.*

The effects of chemicals as influencing the color, growth and character of several species of fungi are reported. The changes produced are often sufficient to shift the fungus from one order to another.

The effect of light upon growth, spore formation and zonation of colonies, of several species of fungi is reported.

Under the heading of "unknown factors" several changes of character which could not be attributed to environment are mentioned.

DUNCAN S. JOHNSON,
Secretary

JOHNS HOPKINS UNIVERSITY

THE ASSOCIATION OF AMERICAN GEOGRAPHERS

THE fifth annual meeting was held in Baltimore, December 31, 1908, to January 2, 1909, under the presidency of Mr. G. K. Gilbert. Professor Albrecht Penck gave a lecture before the association at its opening session on Thursday evening, on "Man, Soil and Climate." Other features of the meeting were: the president's address by Mr. Gilbert, on the subject "Earthquake Forecasts," and a round table conference on "Geography for Secondary Schools," conducted by Professor R. E. Dodge. The conference was held informally in connection with a smoker at the Johns Hopkins Club on Friday evening. About thirty papers were read by members, representing meteorology and various phases of physiographic, biological, human and educational geography.

The important subject of cartography was also well represented. The officers for the ensuing year are:

President—W. M. Davis.

First Vice-president—L. A. Bauer.

Second Vice-president—E. R. Johnson.

Secretary—A. P. Brigham.

Treasurer—N. M. Fenneman.

Councilors—Cyrus C. Adams, R. S. Tarr and R. E. Dodge.

The place of the next meeting will be fixed by the council.

The following is a list of papers presented:

"Man, Soil and Climate" (public lecture), by Albrecht Penck.

"Earthquake Forecasts" (president's address), by G. K. Gilbert.

"Round Table Conference on Secondary Geography," by R. E. Dodge.

"Accumulation of Inherited Features in Shorelines of Evolution," by J. W. Goldthwaite.

"On the Elements of the Surface Sculptured by Glaciers," by W. H. Hobbs.

"Existing Glaciers of the Northern Hemisphere," by O. D. Von Engeln.

"The Topographic A B C of Land Form," by F. E. Matthes.

"How May the Teaching of Geography in Elementary Schools be Improved?" by C. T. McFarlane.

"Apparatus for Instruction in the Interpretation of Maps," by W. H. Hobbs.

"Some Practical Results of the Ninth International Geographical Congress," by H. G. Bryant.

"Three Gatherings of Geographic Interest," by A. P. Brigham.

"Status of the Magnetic Survey of the Earth," by L. A. Bauer.

"A Reconnaissance in the Arctic Slope of Alaska," by E. D. Leffingwell.

"The Climate of Cuba," by H. Gannett.

"The Temperature at Great Heights above the American Continent," by A. L. Rotch.

"The Climate of the Historic Past," by E. Huntington.

"Origin of Civilization through Intermittency of Climatic Factors," by J. R. Smith.

"The National Forest Policy," by H. A. Smith.

"Some Results of the Recent Census in Cuba," by H. Gannett.

"The Anthropography of Some Great Cities," by Mark Jefferson.

"The Capacity of the United States for Population," by A. P. Brigham.

"Geographical and other Influences affecting the Pottery Industry of Trenton, N. J.," by R. H. Whitbeck.

"Geographical Influences in the Development of Ohio," by F. Carney.

"Trade Routes in the Economic Geography of Bolivia," by I. Bowman.

"The Influence of the Precious Metals on American Exploration, Discovery, Conquest and Possession," by G. D. Hubbard.

"The Stream Robbery on which the Belle Fourche Reclamation Project is Based," by N. H. Darton.

"A Remarkable Glacial River and its Modern Representative," by F. Taylor.

"Delta Form and Structure of the Thames River Terraces, Connecticut," by F. P. Gulliver.

"The Requisites of a School Wall Map," by J. P. Goode.

A. P. Brigham,
Secretary

THE SOCIETY FOR HORTICULTURAL SCIENCE

At a business meeting of the society held in Baltimore, December 31, 1908, several important questions were discussed. The committee appointed at the Jamestown meeting to interview the Secretary of Agriculture with reference to having the annual reports of the society published by the Department of Agriculture reported that they had interviewed Dr. B. T. Galloway, who represented the Secretary of Agriculture in this matter, and that it was almost certain that the department would publish the reports, provided the following amendments were adopted by the society:

"That the association shall be known as the American Association of Official Horticulturists, the object of which is to promote the science of horticulture, and that any person connected with a state or federal experiment station or with the U. S. Department of Agriculture or its territorial stations, or with any other institution in the United States or Canada, who is engaged in the teaching of horticulture, or in experiments bearing upon it, may become a member of the association and shall be entitled to vote on the conditions which are embodied in the present constitution. Furthermore, that all horticulturists in the United States and in Canada, or in any other country engaged in the teaching or investigation of horticulture, may become associate members of the association under the same conditions that govern the admission of members and shall have all the privileges of members except the right to vote and hold office."

These amendments were discussed and were satisfactory to the members present, but the amendments could not be adopted, since the by-laws require that amendments presented at one meeting can not be adopted before the next annual meeting.

It was the sentiment of the society to affiliate with the National Association for the Advancement of Agricultural Science when the organization of the latter society was sufficiently advanced to make this possible and desirable.

The society voted to fix a price of one dollar per copy for its annual reports to new members and to educational institutions, and a price of two dollars per copy to non-members.

The officers and members of committees for 1908 were reelected for 1909.

C. P. CLOSE,
Secretary-treasurer

SOCIETIES AND ACADEMIES

THE KANSAS ACADEMY OF SCIENCE

THE forty-first annual meeting of the academy was held in Topeka during holiday week, and was of unusual interest both in the quality and number of papers presented for discussion. The retiring president, E. Haworth, chose for the subject of his address "The Life History of a River," and discussed the cause of floods, and the means of controlling these destructive agencies. A. J. Smith told how the city of Emporia is securing a good water supply from the underflow of the Neosho river. The pure food and drugs law called forth several important papers from Professors Bailey, Sayre, Willard, Ziefle and Jackson. The biologists reported additions made in the past year to the lists of birds, mammals and insects. Professor Dyche contributed important notes of his experience in preserving the skins of mammals. Dr. Williston sent a paper on the "Skull Structure of Diplocaulus" with restoration, and C. H. Sternberg, the enthusiastic fossil hunter, gave an account of his last summer's finds in the Laramie beds of Wyoming.

One evening was given to memorial exercises in honor of the late Dr. Francis Huntington Snow, one of the founders of this academy, and for more than forty years connected with the University of Kansas, where he held the office of chancellor for twelve years. One of his earliest colleagues, Professor E. Miller, gave a memorial address, and other members spoke of him as a collector, teacher and contributor to scientific discovery. Another evening session, held in Washburn College, was in part a social occasion, and was otherwise made interesting by Professor Edmondson giving some excellent stereopticon views illustrating an account of his last summer's trip to Tahiti. Professor Parker gave some fine specimens of bird photography, and Professor Sternberg exhibited some good views of the Laramie beds of Wyoming.

The officers elected for the ensuing year were as follows:

President—F. B. Dains, Topeka.
First Vice-president—J. M. McWharf, Ottawa.
Second Vice-president—A. J. Smith, Emporia.
Treasurer—F. W. Bushong, Lawrence.
Secretary—J. T. Lovewell, Topeka.

Ottawa was selected as place for the next annual meeting.

The following papers were presented:

Papers, illustrated by stereopticon:

"Some Glimpses of Tahiti," by C. F. Edmondson.

"Notes on Photography of Wild Birds," by J. B. Parker.

Chemical and Physical Papers

"Resins in Vanilla Extract," by H. L. Jackson.

"An Examination of Apparatus for a Simple Determination of Carbon Dioxid in Air," by E. H. S. Bailey.

"Sulphites as Preservatives," by Edith A. Goodwin and E. H. S. Bailey.

"The Character of the Mid-continent Petroleum," by F. W. Bushong.

"Fluctuations in the Mineral Contents of the Kaw River," by F. W. Bushong and A. J. Weith.

"The Importance of Pharmacological Methods in Drug Assay," by Adolph Ziefle.

"Suggested Legislation in Regard to the Selling of Cocaine," by H. W. Emerson.

"Enameling Steel," by R. D. Landrum.

"The Relation of Manganese to the Corrosion of Iron," by H. P. Cady.

"Progress of Work in Drug Analysis under Pure Food and Drugs Law," by L. E. Sayre.

"Comments on Analysis of Spices," by L. E. Sayre.

"Study of the Cause of Coal-mine Explosions," by E. Haworth and C. M. Young.

"The Medullary Ray as an Element of Strength in Structural Timber," by F. E. Jones.

"On some Methylene Derivatives," by F. B. Dains.

"Recent Investigations of the Properties of Steam," by P. F. Walker.

"Pelton Water-wheel Test made at the University of Wisconsin in the Summer of 1908," by Chas. I. Corp.

"Some Notes on the Steel-hardening Minerals," by J. C. Cooper.

"A Speculation in Crystallography," by J. E. Todd.

"Economy of Heat in Cooking," by J. T. Lovewell.

"Some Difficulties in Testing Food for Sulphites," by J. T. Willard and C. A. A. Utt.

Geological Papers

"Some Notes on the Olympic Peninsula, Washington," by A. B. Reagan.

"The Formations of the Marion Stage of the Permian," by J. W. Beede.

"Why the Southern Hemisphere is the Principal Water Hemisphere and the Northern the Principal Land Hemisphere," by J. J. Jewett.

"The Drainage of the Kansas Ice Sheet," by J. E. Todd.

"Expedition to the Laramie Beds of Converse County, Wyoming, 1908," by C. H. Sternberg.

"A Study of Certain Features of the Lawrence Shales," by J. A. Yates.

"The Extremities and Skull Structure of Diplocaulus, with Restoration," by S. W. Williston.

"The Skull Structure of *Diplocaulus magnicornis* Cope," by R. L. Moodie.

"Carboniferous Quadrupeds of Kansas," by R. L. Moodie.

Biological Papers

"A New Bird for the Kansas List, taken at Lawrence," by L. L. Dyche.

"Supplementary Additions to the List of Kansas Diptera," by E. S. Tucker.

"Weismann's Germ Plasm Hypothesis Untenable," by L. C. Wooster.

"Notes on a Captive Heloderma," by B. B. Smyth.

"The Birds of the Olympic Peninsula, Washington," by A. B. Reagan.

"Trees and Shrubs of Kansas," B. B. Smyth.

"Distribution, Natural Enemies and Breeding Habits of the Kansas Pocket Gophers," by T. H. Scheffer.

"The Poison Glands of a Rattlesnake during the Period of Hibernation," by L. L. Dyche.

"Notes on Bats," by Lumina C. R. Smyth.

"The Latest Tests for Gas-forming Bacteria in Water," by W. B. Wilson.

"Additions to the List of Kansas Coleoptera," by W. Knaus.

"Some Notes on Kansas Coleoptera," by W. Knaus.

"Note on the Northern Distribution of *Amblychila cylindriformis* Say," by W. Knaus.

"Kansas Coleoptera of the Families Colydiidæ, Cucujidæ, Cryptophagidæ, Mycetophagidæ, Dermestidæ, Histeridæ, Nitidulidæ, Lathridiidæ, Trogositidæ, Parnidæ, Heteroceridæ, Dascyllidæ and Rhipiceridæ," by W. Knaus.

"Intercellular Spaces in Plants," by L. A. Kenoyer.

"Some Notes on the Common Mole," by T. H. Scheffer.

"Coccidæ of Kansas," by G. A. Dean.

"Notes on Kansas Mammals," by D. E. Lantz.

"Some Interrelations of Protozoa," by C. H. Edmondson.

"List of Insect Types and Co-types in the Collection of the University of Kansas," by C. H. Withington.

"Habits of Parasitic Hymenoptera, II.," by C. H. Withington.

Miscellaneous Papers

"The Importance of having Standard Weights and Measures," by E. F. Stimpson.

"Temporary Industrial Fellowships," by R. E. Duncan.

"Railway Rates from an Engineering Standpoint," by B. F. Dalton.

"The Centenary of Charles Darwin," by A. H. Thompson.

"Estimation of the Relative Value of Feeds," by E. B. Cowgill.

"Further Notes on the Influence of Heredity in Stock-breeding," by I. D. Graham.

"Ups and Downs of our Homes from an Architect's Point of View," by N. P. Nielsen.

"Some Glimpses of Tahiti," by C. H. Edmondson.

"Cancer," by J. M. McWharf.

"The Cause and Prevention of Tuberculosis," by S. C. Emley.

"An Improved Water-supply for the City of Emporia," by A. J. Smith.

"A Speculation in Crystallography," by J. E. Todd.

"Indian Remains in the Canadian River Valley," by T. L. Eyerly.

"Notes on Photography of Wild Birds," by J. B. Parker.

"A New Geometrical Figure and its Possible Application," by E. C. Warfel.

"Preliminary Note on Measuring the Speed of Photographic Shutters," by H. I. Woods.

"Views and Notes from Utah," by I. D. Cardiff.

THE ASSOCIATION OF TEACHERS OF MATHEMATICS IN THE MIDDLE STATES AND MARYLAND

THE eleventh meeting of the Association of

Teachers of Mathematics in the Middle States and Maryland was held at Franklin and Marshall College, Lancaster, Pa., on November 28. After the address of welcome by President Stahr, the following papers were read:

"Training versus Facts," by William Henry Metzler, Syracuse University.

"Elementary Logic as a Basis for Plane Geometry," by Eugene Randolph Smith, Polytechnic Preparatory School, Brooklyn, N. Y.

"The International Commission on the Teaching of Mathematics," by David Eugene Smith, Teachers College, New York City.

"Checks, Their Use and Abuse, by William E. Breckenridge, Stuyvesant High School, New York City.

"Historical Mathematical Material from the East," by Miss Bertha L. Broomell, Teachers College, New York City.

The annual election of officers was held; the officers elected follow:

President—William Henry Maltbie, Woman's College, Baltimore, Md.

Vice-president—William E. Breckenridge, Stuyvesant High School, New York City.

Secretary—Eugene Randolph Smith, Polytechnic Preparatory School, Brooklyn, N. Y.

Treasurer—Emma Hazleton Carroll, High School for Girls, Philadelphia, Pa.

Members of the Council—William H. Metzler, Syracuse University; Susan C. Lodge, Philadelphia Collegiate Institute for Girls.

The council appointed ten delegates to the American Federation, a committee on publication, composed of William H. Metzler, *chairman*, Eugene R. Smith, Jonathan T. Rorer, and a committee on mathematical work in continuation schools, having as chairman William E. Breckenridge.

The following amendment to the constitution was recommended by the council:

Paragraph I. of Section II., to read:

"The annual meeting shall be held at a time and place to be selected by the council."

The spring meeting of the association will be held at Syracuse University on Easter Saturday.

EUGENE R. SMITH,
Secretary.

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 452d meeting was held January 9, 1909, with President Palmer in the chair. The following papers were presented:

The Type of the Genus Cactus: J. N. ROSE.

Present Status of the Cotton Boll Weevil: W. D. HUNTER.

The speaker discussed especially two of the most important biological questions that have arisen on account of the invasion of the cotton belt by the boll weevil. These questions are, first, the extent to which the insect is capable of adapting itself to the conditions of this country which are radically different from those of the original home, and, second, the effect on the indigenous fauna in this country.

The wide variation in rainfall, geological formation and other respects in areas that have been invaded was described. The rainfall varies from 12 to 50 inches; the elevation from sea level to 2,500 feet, the absolute minimum temperature from $-20°$ F. to $+20°$ F. These variations have caused distinct agricultural provinces to arise, and, indeed, have been so important that they have had an effect towards establishing races of men. The weevil has maintained itself in all this region, but has been most affected by dryness. The cotton plant has an advantage over the weevil in this respect, which indicates that cotton production in western Texas is certain to increase enormously. It is not too much to suppose that the increase in that quarter will offset the falling off in other parts of the belt.

The boll weevil has had very important effects upon the local insect fauna. A number of parasitic and predaceous insects have changed from the original indigenous hosts to the immigrant. Eight predaceous forms attack the adult, 15 similar forms attack the larva, 24 hymenopterous parasites also attack the larva. These parasites also attack 48 species of weevils. The boll weevil complex, therefore, comprises 49 weevils which feed upon 95 plants and 97 insect enemies of these weevils. The interrelationship is so intimate that a factor that will affect any one of the 95 plants in the complex may react upon the boll weevil.

It was pointed out that the boll weevil problem has recently taken on entirely new aspects in the Mississippi Valley. The heavy precipitation, abundance of timber and poor drainage have caused the problem to be much more serious than it was in Texas. This has been shown during the season of 1908 by a great falling off in the production of cotton in Louisiana and the infested portion of Mississippi.

The best hope for the future is in the insect enemies of the weevil. The climatic conditions in Texas that have checked the weevil have also checked the parasites. With the removal of these

checks in the Mississippi Valley it is supposed that the efficiency of the parasites will be proportionately much greater than it has been elsewhere. Practical experiments have been conducted which show that the artificial introduction of parasites that have adopted themselves to the boll weevil in Texas is a hopeful line of assistance to the cotton planter.

Investigations of Toxoptera graminum and its Parasites: by F. M. Webster.

This is a species of aphis which on account of its depredations has come to be known in the grain-growing sections of the southeast and southwest as the green bug. Invasions occur at irregular intervals both in this country and in Europe, when it breeds in immense swarms, not only proving exceedingly destructive, but the winged insects flying or drifting about in clouds, sometimes becoming troublesome to people.

It is known to occur in southern Europe, Hungary, Belgium, in Siberia and in the Orange River Colony, South Africa. In the United States it extends from Mexico and the Gulf northward to Canada, excepting in the central New England states. It also occurs on the Pacific coast. It inhabits elevations of only a few feet above the sea level to the high plateaus of the west at an elevation of eight thousand feet.

While preferring grain, especially oats, it breeds on the following grasses: *Poa pratensis*, which is a common food plant all over the north; *Alopecurus geniculatus*, *Agropyron occidentalis* and *Hordeum pusillum* in Oklahoma, Kansas and Colorado; *Agropyron tenerum*, *Bromus portei*, *Elymus striatus*, *Hordeum cæspitosum*, *Polypogon monspeliensis* and *Stipa vividula* in New Mexico; *Distichlis spicata* and *Hordeum jubatum* in Montana; *Setaria glauca* in Indiana; and *Dactylis glomeratus* in the northern states and Virginia. In the northern section of the country its principal food plant seems to be blue grass.

Its destructive outbreaks in the United States seem to be regulated by the mild winters and cold springs, not so much on account of the influence of temperature upon the insect itself as upon its principal parasite *Lysiphlebus tritici* which ordinarily holds it in check. Wintering over in the north in the egg stage; in the central portion of the country as far south at least as Tennessee and southern Kansas, both in the egg and as viviparous females; and as the male and sexual female of *Toxoptera graminum* may also occur in the spring, it seems quite possible that in the far south, in the region of the Rio Grande River, this aphid may pass the dry season instead of the winter in the egg stage, although this has not yet been proved. While the egg-laying female is quite distinct from the viviparous female, individuals frequently occur that are both oviparous and viviparous. The oviparous female produces very few eggs, probably not to exceed a half dozen. The young hatching from these eggs are all of them viviparous females and in the north these continue to remain viviparous until fall and sometimes even through the entire winter.

The principal parasite, *Lysiphlebus tritici*, is parthenogenetic, the offspring of virgin females being usually all males. Occasionally there are females, and these being kept virgin have produced an occasional female to the third generation from the mated female. These parasites deposit their eggs singly in the body of the *Toxoptera*, and the larva when it becomes full grown lines the now empty body of its host with silken threads and attaches the cocoon to the leaf of the plant. These cocoons cause the body of the host to assume a rotund appearance and brownish color and where the insect is excessively abundant and the parasites increasing rapidly these brown bodies become so thick as to give a field of wheat or oats observed at a distance a brownish tinge.

Other insect enemies are the lady beetles, Coccinellidæ, a minute *Aphelinus* and probably a larva of a small fly belonging to the genus *Leucopsis*.

M. C. Marsh,
Recording Secretary

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY

At a meeting held at the Museum of Natural History, on Monday, January 18, Dr. O. W. Willcox presented a paper entitled "Cylindrogenite, a Possible Representative of a Cylindrical (Non-Hauyan) Order of Crystals," in which he described a remarkable new form of limonite which occurs in the Red Bank sand of the Upper Cretaceous of New Jersey. The limonite, var. Cylindrogenite, occurs normally as perfect cylinders (which may be either hollow or solid), terminated at either end by a cone or a hemisphere. Two or more cylinders frequently intergrow, forming aggregates in which each cylinder preserves the alignment of its own axis; a number of such aggregates and also a number of photographs were exhibited. A most careful and painstaking study extending over more than three years having failed to suggest any other possible origin for these

objects, Dr. Willcox makes the novel suggestion that they are representatives of a non-Hauyan order of crystals, which he proposes to call the cylindrical system, as distinguished from the cubical and other systems of the Hauyan order. The speaker pointed out that there are no *a priori* reasons for regarding the Hauyan order as the sole mode of expression of crystalline nature; he knew of no reason why nature should be regarded as impotent to fashion a crystal after the form of a cylinder as well as after the form of a cube. As the facts indicate that the cylinders were formed by molecules of dissolved matter in the act of separating from solution to constitute the solid phase, and in so doing assumed a geometrical form of consistent regularity, they are as much entitled to be regarded as crystals as are the cubes which are formed when sodium chloride separates from solution. The cylinder being a geometrical form of higher symmetry than the cube, the absence of distinguishing crystallographic characters as seen under the microscope would be accounted for; and hence a crystallographic investigation shows nothing out of the ordinary.

Professor D. W. Hering read a paper on "Orthopedic Photography, Notes on the Rectification of Distorted Pictures." The paper discussed the defects common in kodak pictures, which arise from badly timed exposure in various conditions of light, followed by development of a whole set of films at once, resulting in excessive inequalities of light and shade. In printing from such a negative, if the source of light is small, as a gas flame or incandescent bulb, these faults can be corrected to a great extent by holding the printing frame in such a position that the distance to different parts of the negative gives different intensity of illumination, and the subsequent development of the print is normal. It also considered the distortion of pictures arising from using a short focus lens, and holding the camera at an awkward angle, as, for instance, pointing it upward or downward at a considerable inclination. By rephotographing the distorted picture, placing it before the camera at an angle to the axis of the lens, a counter distortion is effected which under judicious management rectifies the picture and sometimes improves it. The discussion was directed entirely to correction of defects by physical treatment instead of chemical. Numerous lantern slides illustrated the various stages of these corrective processes.

Professor W. Campbell read "Some Notes on Western Smelters." A series of lantern slides intended to show the evolution of the western lead smelters on account of changes in conditions and improvements in practise. A photograph of the Globe Smelter, Denver, showed the location of the main buildings. A plan of the plant showed the receiving tracks, bins for fuel, fluxes and ore, the beds, the various roasters, the blast-furnaces and the matte settling reverberatories, flues, bag-house, the old refinery, etc. A tree of smelting showed the course of the materials. Other slides showed the handling of raw materials, the methods of bedding at different plants; of roasting, briquetting of fines; the blast-furnace, types, methods of charging, tapping of lead, of matte and slag, the separation of the same, handling of foul slag, etc. Level versus sloping sites shown by contrasting photographs of the Murray plant with those of the Leadville, Eilers, Pueblo, etc. Two copper smelters were described: the Highland Boy at Bingham, with 20 McDougall and 3 Wethey roasters, 9 reverberatory smelters and 4 converter stands; the Garfield plant, with 2 blast-furnaces and 3 reverberatory smelters, 4 converter stands, the oxide and sulphide mills, beds, roasters, the Huntington-Herberlein equipment for roasting fine concentrates, etc.

W. CAMPBELL,
Secretary

COLUMBIA UNIVERSITY,
NEW YORK CITY

SECTION OF GEOLOGY AND MINERALOGY

AT the regular meeting of December 7, 1908, the evening was devoted to the conditions and problems that have developed by tunneling the Hudson River gorge. Many engineers directly concerned in these enterprises or related ones were present and joined in the discussion.

The following three papers were read summarizing the accumulated data and suggesting the history and structure indicated by them.

"Our Knowledge of the Filled Channel of the Hudson in the Highlands and the Submerged Gorge on the Continental Shelf," by Professor J. F. Kemp. It was shown that the depth now known, over 650 feet, at Storm King Mountain, 50 miles above New York, is greater than at any other point in the whole drainage system except far out on the continental shelf.

"A Summary of an Investigation into the Structural Geology of Southern Manhattan and the Condition of the East River Channel," by Dr. Charles P. Berkey. The results of identification of material recovered from 300 drill borings in southern Manhattan and the adjacent channels

were shown. In this area there are no rock outcrops and nothing is known of bed rock type or condition except what can be determined in this way. It is now certain, however, that the southern end of the island is not wholly underlain by Manhattan schist as formerly mapped, but that the east side is made up of the usual succession of folded Fordham gneiss, Inwood limestone and Manhattan schist.

"Some of the Latest Results of Explorations in the Hudson River at New York City," by Dr. E. O. Hovey. Borings made by the Pennsylvania Tunnel Company across the Hudson on the line of Thirty-second Street were shown and interpreted. Bed rock has been penetrated at three points in the gorge proper. All are approximately 300 feet deep to rock. But since these holes are nearly 1,200 feet apart, the interesting question of a possible narrow inner gorge still remains. Seeing that the proved depth in the Highlands is at least 350 feet deeper than is yet found at New York City, the Hudson problem may still be considered an open one.

Charles P. Berkey,
Secretary of Section

THE AMERICAN CHEMICAL SOCIETY
NORTHEASTERN SECTION

The eighty-eighth regular meeting of the section was held on December 18, at the Chemical Laboratory of Harvard College, Cambridge. An address upon "The Systematic Relations of the Compressibilities of Elements and Simple Compounds" was delivered by Professor Theodore W. Richards, of Harvard University. The speaker called attention to probable relationships between the compressibilities of the elements, the changes of atomic volumes upon the formation of compounds, and the chemical affinities as measured by heats of reaction. After pointing out the lack of reliable data concerning the compressibility of substances, he described the apparatus in use by himself for the determination of this constant and stated that values for the compressibility of thirty-five elements and a number of compounds had already been obtained. It was shown that the compressibility is a periodic function of the elements and that the relationships with atomic volumes and heats of reaction are in remarkable agreement with the predictions. Some striking relationships among organic compounds were cited and it was stated that further work is being done upon the study of isomers.

Professor Bertram B. Boltwood, of Yale University, briefly described the recent work of Professor Rutherford upon the "α rays."

The eighty-ninth regular meeting of the section was held at the Massachusetts Institute of Technology on January 22. The following papers were presented: "Fundamental Principles underlying the Decay of Structural Materials," by Professor W. H. Walker, of the Massachusetts Institute of Technology, a concise statement of the electrolytic theory of the corrosion of iron; "Protective Coatings for the Conservation of Structural Materials," by Mr. Robert S. Perry, president of the scientific section of the Paint Manufacture Association of the United States, an account of work being done in testing the porosity and elastic strength of paint skins and the inhibitive or stimulative effect of certain pigments on the rate of corrosion of metals.

Kenneth L. Mark,
Secretary

THE SCIENTIFIC ASSOCIATION OF JOHNS HOPKINS UNIVERSITY

The association held its monthly meeting January 13, when it was addressed by Professors J. M. Baldwin and J. B. Whitehead.

Professor Baldwin spoke upon the subject of "Genetic Science," classifying sciences as genetic or agenetic. He showed the ground for the distinction between them to be that they are qualitative and quantitative, respectively.

The limitations of quantitative science were pointed out while recent advances in the scientific and philosophical theory of genetic science were discussed. Quantity and quality both represent special points of view, each requiring a certain abstraction and limitation with respect to the actual events of nature. It is the task of philosophy to affect the synthesis which will not disqualify either.

Professor Whitehead discussed the problem of the "Electrification of Steam Railways." Steam railways are being transformed and operated electrically in tunnels in order to secure freedom from gases due to combustion; in terminals to increase traffic capacity, and on through service in order to lessen cost of operation. Coal consumption and cost of repairs are lessened. It was shown that the electrification of all the steam railways of the country would lessen the total consumption of coal of the country about 7 per cent.

C. K. Swartz,
Secretary